SEP 0 1989

SIX DOLLARS

A CAHNERS PUBLICATION

# Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

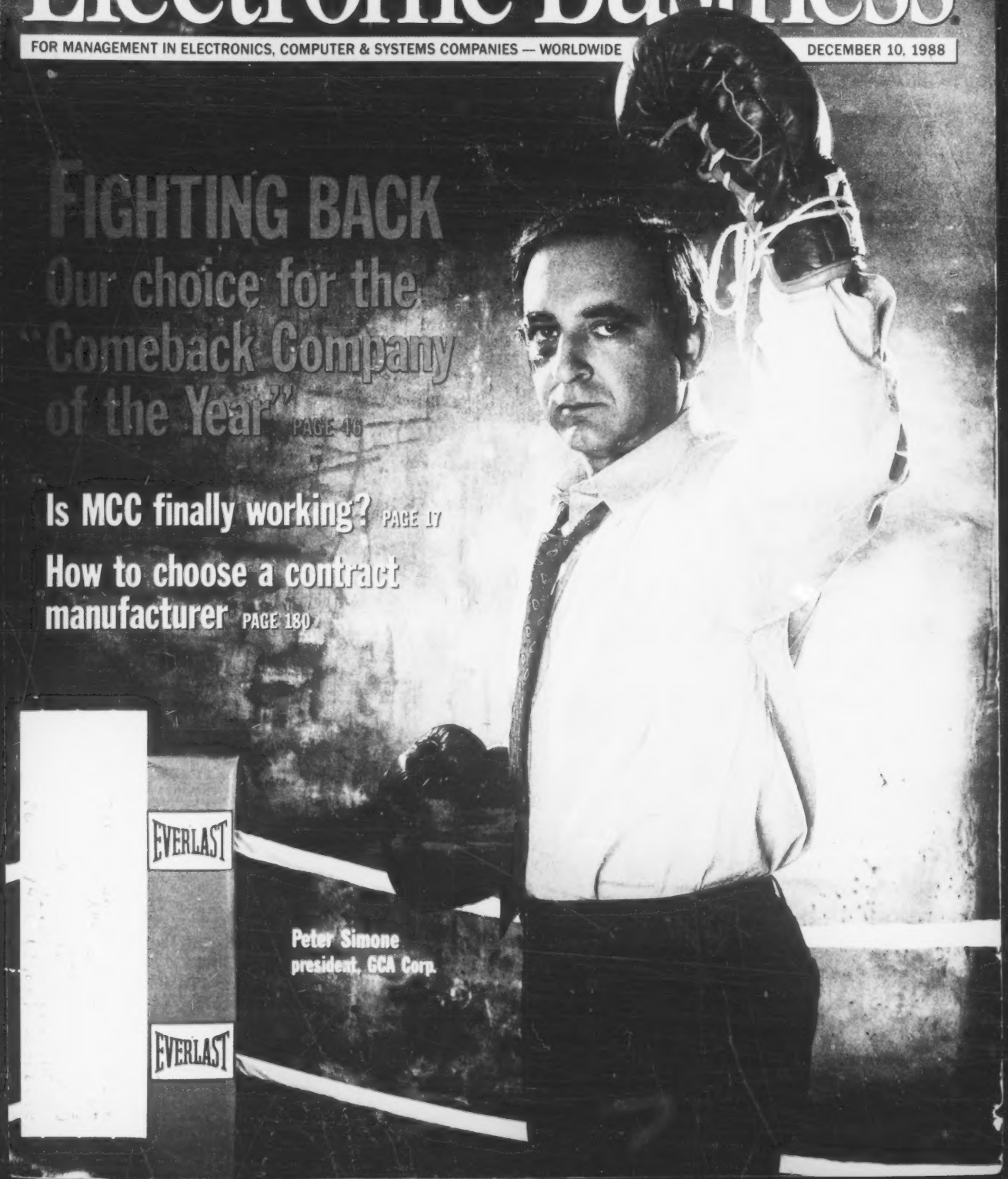
DECEMBER 10, 1988

## FIGHTING BACK

Our choice for the "Comeback Company of the Year" PAGE 46

Is MCC finally working? PAGE 17

How to choose a contract manufacturer PAGE 180




Peter Simone
president, GCA Corp.

# Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 14, NO. 23 DECEMBER 10, 1988

**PAGE 46 GCA's Peter J. Simone comes back from a near knockout**

Cover photograph: Renee Fraser


COVER STORY/STRATEGIES

## 46 Fighting back: GCA is the "Comeback Company of the Year"

GCA's president Peter J. Simone used to box in college, but he was hardly prepared for the semiconductor industry slump of 1985 which hit the General Signal division like a knockout punch. But, under extraordinarily difficult conditions, GCA's management team has staunched a three-year flow of red ink and brought the company back from the brink of financial disaster.

BUSINESS TRENDS

**17 MCC and other research clubs: Do they work?**
One product doesn't prove it. But participants are still enthusiastic about the electronics industry consortium

**18 TI throws its hat into the Unix AI ring**
TI's strategy to become a leader in the Unix-based workstation market rests on its AI efforts. When will those efforts pay off?

**26 Third World markets for 32-bit workstations**
Apollo thinks developing nations could use workstations for "social engineering." But, it may take the World Bank to make it work.

**32 Swedish-Swiss merger braces European electronics**
From ICs to thyristors and relays, electronics already yield over 20% of Asea Brown Boveri's $18 billion in sales.

**38 Wyle goes national in search of distribution sales surge**
Wyle sets up shop on the East coast next month to peddle computers *and* components. But what will the plan do for profits?

STRATEGIES

**46 GCA is the "Comeback Company of the Year"**
Almost down for the count, Peter Simone and his management team brought GCA back from the brink of disaster.

**56 Shopping spree: Foreign firms expand in the U.S.**
The cheap dollar has made U.S. expansion a bargain. And fears of protectionism have made growth here a high priority for overseas firms.

- Top foreign companies in the U.S.

**62 Sound body, sound company: Body builder builds business**
Lean and mean, Capital Associates chairman Richard Kazan lifts weights and high-tech leasing revenue.

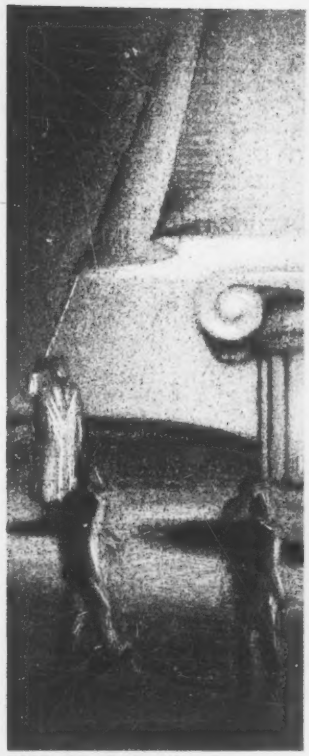
**98 Can fierce Winchester competitors become partners?**
Maxtor's George Scalise wants U.S. drive makers to form a consortium to counter the Japanese. His biggest problem may be convincing his counterparts that it's necessary.

**106 Lifetime costs edge out MIPS in sales pitches**
"Cost of ownership" is the new computer marketing watchword as hardware prices fall below 30% of total system costs.

MANAGING TECHNOLOGY

**116 Taking the wraps off the technologies of the 1990s**
Deciding which of tomorrow's technologies to back is a critical step for executives hoping to gain an edge.

**122 How do venture firms pick a winner? Carefully**
A new technology isn't all venture firms will judge a start-up on.



**PAGE 116 Taking the wraps off the technologies of the 1990s**

**PAGE 145 Hyundai's H.S. Shin: Korean firms wrestle with the U.S. PC market**

**PAGE 56 Shopping spree: Foreign firms expand in the U.S.**

**PAGE 62 Capital Associates' Richard Kazan likes his company lean and mean**

**PAGE 128 Chips and Technologies' Gordon Campbell doesn't clown around with venture capital**


## MANAGING RESOURCES

**128 Start-up success? It *can* be done without venture funds**
Rich aunts, big corporate partners and even Uncle Sam get plenty of new firms off to good starts — but they can't always match those old VC connections.

**136 How Mentor Graphics stays young and fit**
The computer-aided engineering pioneer, no longer a scrappy start-up, gives its managers a long rope, with plenty of operating freedom.

## ASIA/PACIFIC BUSINESS

**145 Korean PC firms make impressive inroads here**
But as wages and the value of the won rise, profits are falling. Korean electronics giants realize that to survive, they must offer more than just low prices.

**154 U.S. computer firms go shopping in Taiwan**
Just about every major computer company does its shopping in Taiwan. IBM spent $278 million there last year. Here's why.

## MARKET PERSPECTIVES

**165 Software that links design to test: A step closer?**
Board makers want ATE vendors to cut their test costs; vendors say users must take design initiatives. Board complexity is forcing a resolution.

## BUSINESS BAROMETER

**217 Communications**
Increases in equipment investment are slowing and the gain from exports won't be as great next year.

**218 Computers**
Increases in shipments help mitigate fears that purchases of PCs are slowing down.

**220 Leading indicator**
An unusual pattern of stability suggests 1989 will be a flat year for semiconductors.

## DEPARTMENTS

5 **Inside Business**
9 **Letters**
11 **Upstarts**
Gillytron, KoFax Image Products, Unison Technologies

175 **Executive Viewpoint**
Hayao Nakahara, PCK, suggests that if U.S. PWB makers don't shape up, Japanese suppliers could invade the market.

180 **Comment**
How to choose a contract manufacturing company.

188 **Comment**
ISDN is changing the face of telecommunications.

196 **Executive Viewpoint**
James Morgan, of Applied Materials, on the promise to the West of Soviet Reform

202 **Editorial Index**
210 **Coming Attractions**
215 **My View**
The handshake partnership. And trust.

216 **Advertiser index**
226 **Viewpoint**
So you think you know Europe?

## COMPANIES IN THIS ISSUE

210 **An index of the companies covered in this issue.**

**EDITORIAL STAFF**

**Publisher:** Frank J. Burge

**Editor:** Allen Furst

**Managing Editor:** John Kerr

**Assistant Managing Editor:** Beth Karlin

**Senior Editors:** Alden M. Hayashi, Linda Stallmann, Anne Knowles, Bruce C. P. Rayner, Valerie Rice

**Associate Editors:** Barbara Berkman, Rick Whiting

**Assistant Editors:** Anthony E. Greene, John McCreadie, Xiong Xiaoge

**Copy Editor:** Barbara Jorgensen

**Editorial Assistant:** Sherri Hartlen

**Contributing Editors:** Norman Alster (Special Projects), Elizabeth Bartz (Cahners Economics), Euan Barty (Hong Kong), Dwight Davis (Boston), Madeline Franchi (Cahners Economics), Jack Gee (Paris), Sarah Glazer (Boston), Steve Gross (Minneapolis), Shohei Kurita (Tokyo), Michael Leibowitz (Boston), Tom McCusker (Los Angeles)

**Consulting Editor:** Alberto Socolovsky

**Managing Editor Production:** Roger C. Plant

**Production Editor:** Linda S. Cohen

**Assistant Production Editor:** Karen J. Covey

**ART STAFF**

**Art Director:** Bill Cooke

**Associate Art Director:** Mike O'Leary

**Staff Artist:** Christina Rutter

**EDITORIAL OFFICES**

**Boston:** Cahners Building
275 Washington Street, Newton, Mass. 02158 (617) 964-3030 Telex: 94 0573 CPC BSN 650502256 MCI Fax: 617-964-5490

**San Jose, Calif.:** Valerie Rice
Sherman Building, 3031 Tisch Way, Suite 100, San Jose, Calif. 95128 (408) 296-0868

**Irvine, Calif.:** Bruce C. P. Rayner
18818 Teller Avenue, Suite 170
Irvine, Calif. 92715 (714) 851-9422

**Northwest:** Paula Doe
5011 133rd Place SE
Bellevue, Wash. 98006 (206) 641-0903

**Paris:** Jack Gee
11, rue de Vaugirard, 75006, Paris, France
011-331-4-354-4200 Telex: 21 4235

**PRODUCTION**

**VP Production:** Wayne Hulitzky

**Director of Production/Manufacturing:** John R. Sanders

**Production Supervisor:** Bill Tomaselli

**Production Manager:** Betsy Harkins (617) 964-3030

**CIRCULATION**

**Group Circulation Manager:** Eric Schmierer

**Assistant Circulation Manager:** William Lazo
44 Cook Street, Denver, Colo. 80206 (303) 388-4511

**Total Circulation:** 76,550

**REPRINTS**

ELECTRONIC BUSINESS articles are available on a custom printing basis at reasonable prices. Contact Joanne Westphal, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5080, Des Plaines, Ill. 60018 (312) 635-8800

# And the winner is . . .

Nobody can forget 1985, when the semiconductor industry slump hit the electronics industry like a hard right to the jaw. GCA Corp. was one of many firms sent reeling by the impact. But the wafer stepper company, since purchased by General Signal Corp., fought back. And president Peter J. Simone, who obligingly posed for us wearing theatrical bruises and boxing gloves, is enjoying the victory. For its efforts, ELECTRONIC BUSINESS has named the Andover, Mass., firm as its 1988 "Comeback Company of the Year."

VLSI Research Inc., a San Jose market research firm, projects that GCA will capture 13% of the estimated $940 million wafer stepper market for 1988, up from 6% last year. Our cover story marks the ELECTRONIC BUSINESS debut of Rick Whiting. Rick comes to ELECTRONIC BUSINESS as an associate editor from *Computer Systems News*. He will be keeping a close watch on the computer industry.

**Associate editor Rick Whiting**

### High cost of test

As printed circuit board complexity rises and surface mount technology gains acceptance, the high cost of test has become a critical concern. Indeed, pressures to reduce those costs are starting to reshape the automated test equipment (ATE) industry as newcomers emerge with low-cost gear and the established vendors answer with solutions of their own. Turn to our "Market Perspectives" story by associate editor Tony Greene for more on this trend.

### Consortium craze

In recent years, more than 50 consortia have been formed and touted as the salvation of various segments of the U.S. electronics industry. But can U.S. high-tech companies that thrive on cutthroat competition work together while still sharpening their competitive edge? In this issue, two stories explore the modest successes and potential pitfalls of the consortia craze.

In "Business Trends," we examine whether the six years and $200 million pumped into the Microelectronics and Computer Technology Corp. (MCC) were worth it. So far, the collaboration has one product: NCR Microelectronics' CAD software. Meanwhile, in our "Strategies" section, we wonder whether George Scalise, Maxtor Corp. president, will convince fierce Winchester disk drive competitors to drop the boxing gloves and become friendly collaborators.

BETH KARLIN, assistant managing editor

ELECTRONIC BUSINESS® (ISSN 0163-6197) is published semi-monthly, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President; Frank Sibley, Group Vice President; Jerry D. Neth, Vice President/Publishing Operations; J.J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President/Production and Manufacturing. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5800. Telephone: (303)388-4511. Second-class postage paid at Denver, CO 80206-5800 and additional mailing offices. POSTMASTER: Send address corrections to ELECTRONIC BUSINESS® at the Denver address. ELECTRONIC BUSINESS® copyright 1988 by Reed Publishing USA; Saul Goldweitz, Chairman; Ronald G. Segel, President/C.E.O.; Robert L. Krakoff, Executive Vice President; William M. Platt, Senior Vice President. Annual subscription rates for non-qualified people: USA/Canada/Mexico, $55 per year; other countries, $85 per year (including air freight), $170 per year for air mail. Except for special issues where price changes are indicated, single copies of regular issues are available for $6.00, $8.00 and $10.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5800. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Manufacturing • Foodservice & Lodging • Electronics & Computers • Interior Design • Printing • Publishing • Industrial Research & Technology • Health Care • Entertainment. Specialized Consumer Magazines: American Baby • Modern Bride.

VBPA ABP

## Lunch is on me

In your Sept. 1 "Viewpoint," you made a point which I have suspected for some time — unfortunately, money can buy the free press.

We are among the hundreds of small solid electronics and high-tech companies you referred to in your article. We do produce worthwhile products, contribute to the industry and spend hard earned dollars on R&D. We do not have the dollars obviously required to get material published, no matter how newsworthy it might be.

This is where I have a problem. It had always been my naive thought that news was news and was not measured by the money and power behind it. My fellow small manufacturers and I develop informative data sheets, submit product photographs, create clear and concise press releases, and, from time to time, submit technical data to editors.

Past experience indicated that either the material was deemed not newsworthy or it was buried under a pile of other submitted material, or perhaps, as your article seems to confirm, the editors were too busy being contacted and entertained or otherwise engaged with those who can afford to buy luxury.

Although this letter may sound like sour grapes, it is not. In fact, I wish to commend you on your honesty and for having the fortitude to set the record straight. I am personally disappointed to think that the press values news not by its content but by the power of the lobby presenting it. Free publicity is indeed not free; I hope it does not mean that editorial integrity is also a contradiction in terms.

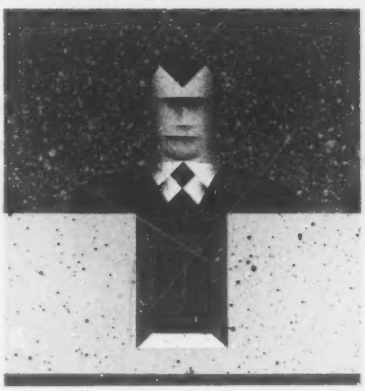
ANTHONY ANDERSON
President, Guildline Instruments Inc.
Orlando, Fla.

*Editor's Note: The point is not that the editorial product is for sale at ELECTRONIC BUSINESS, but rather that information about your products is a commodity. ELECTRONIC BUSINESS is a business — not a technical — magazine. So if we have not printed your technical data and product photographs, it is because it is not our policy to do so — for a company of any size. We might, however, be interested in your business strategy if it is appropriate to our readership. I urge you to consult with your marketing staff about how to best position information for the business press. And by this I do not mean wining and dining reporters. In fact, next time you're in Boston, I will be happy to buy you lunch.*

## R&D spending

Your September 1 feature on R&D investment was informative. I was disappointed, however, that the author's research overlooked the research and development efforts of Network Equipment Technologies Inc. (NET) in the communications segment.

Our fiscal 1987 R&D expenditures, $5.4 million, or $10,800 per employee, outdistanced No. 18 Dynas-



can, which you ranked just below 3Com. Moreover, our numbers represented 11.4% of revenue for that year.

STAN DEVAUGHN
Director, Corporate Communications
Network Equipment Technologies Inc.
Redwood City, Calif.

*Editor's note: To qualify for the ELECTRONIC BUSINESS R&D ranking, companies must derive at least 70% of their revenue from electronics-related sales and be included in the ELECTRONIC BUSINESS 200.*

## Siemens still sleepy

I enjoyed your last issue of ELECTRONIC BUSINESS about Europe, where I spent about half of my career. However, your article about Siemens shows that the slumbering giant is still somewhat in that state. For example, everyone interviewed was a German national with a certain mentality, especially after many years at Siemens. If they mean to be an American company of importance, they need imaginative American marketing and management. It's not enough to buy American companies and turn them into German versions.

Secondly, the European concept that bigness and financial size attract customers is still there. They have to compete like a start-up if they are serious. Thirdly, technical innovation needs to be sent over, so they would be better off to buy advanced companies that need financing than old established companies that make the same thing they make in Germany. In Europe, it was always good enough to make what the others did. Over here, it's better to have something your competition does not.

GEOFFREY POST
Eurotechnology
Irvine, Calif.

## Distribution confusion

In an otherwise well-written story on distribution, we believe that ELECTRONIC BUSINESS erred in calculating certain aspects of the charts on pages 58 to 59 of your September 15 issue. Hall-Mark Electronics Corp. generally employs 1,350 people. Using the $475 million figure reported by Tyler Corp. as our 1987 fiscal sales, that would work out to a little more than $351,000 per employee, not the $146,600 listed in your chart.

JIM BURNETT
Director, Corporate Communications
Hall-Mark Electronics Corp.
Dallas, Texas

*Editor's note: The figures used by ELECTRONIC BUSINESS were for Hall-Mark's parent company, Tyler Corp., not for the Hall-Mark subsidiary. This accounts for the difference.*

## Correction

In our October 1 listing of top capital spenders, Tektronix was incorrectly ranked. With capital expenditures of $66.8 million in 1987, Tektronix should have been in 32nd place.

## Letters to the editor

ELECTRONIC BUSINESS
Cahners Building
275 Washington St.
Newton, Mass., 02158

tors to discuss technology research can be disconcerting at first, but ultimately, says Reinkensmeyer, it's not that different from discussing matters of mutual interest at a technical conference. "We have a ground rule not to discuss any proprietary research going on at member companies," he says.

Reinkensmeyer says his firm probably would not have developed Design Advisor without the preliminary work undertaken by MCC. "You can't expect every activity undertaken by a consortium to be a big hit . . . they take on the risky projects. If it was easy to do there would be no need to share the risk," he says. "But when you come up with a jewel like Proteus, it shows the real value of a combined effort."

The expert system basic design, upon which NCR's software is based, is called Proteus. Developed at MCC, Proteus combines a database with artificial intelligence to pose questions to designers. Knowledge contained in the NCR software provides access to years of experience in designing computer microcircuits, helping detect and eliminate human errors. NCR officials claim Design Advisor can solve design problems in two hours. The same problems, they say, could take 12 weeks with traditional software.

The new software runs on Mentor Graphics workstations. Plans call for it to eventually work with workstations from Sun Microsystems Inc., Daisy Systems Corp. and other companies. "NCR's strategy is to use the software to help differentiate its semicustom chips in the highly competitive ASIC market.

"I think it's the wave of the future," says Gerard Langeler, president of Mentor Graphics Corp. of Beaverton, Ore. He expects chip foundries and workstation manufacturers to use the technology to shorten product development cycles. Andy Rappaport, president of Technology Research Group in Boston, calls the new technology a "model for the kind of thing a consortium can do best." Is it enough to justify all the money that's gone into MCC, Rappaport asks, immediately answering his own question: "Probably not, but it may show the recipe for an optimal way to use consortium dollars in the future."

J. MICHAEL RUHL

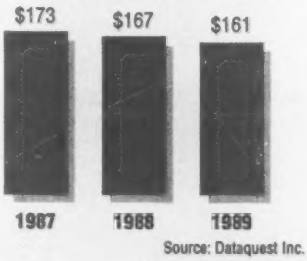
# TI throws its hat into the Unix AI ring

*TI's strategy to become a leader in the Unix-based workstation market rests on its AI efforts. When will those efforts pay off?*

If you admire tenacity, that trait which allows companies to continue investing in a technology whose payback proves elusive, then you'll love the folks at Texas Instruments Inc.

In 1978, TI began a modest program of artificial intelligence research at its central technology labs in Dallas. Ten years later, after spending, by some estimates, several hundred million dollars on research, product development and marketing, TI's AI business has yet to turn a profit, much less pay back its investment. Despite this, TI continues to plow ahead with AI, and has made it the cornerstone of a new strategy to become a leading vendor in the competitive market for Unix-based AI workstations.

**The market for specialized AI workstations shrinks ...**




**... while general-purpose AI workstation sales grow**

TI plans to take the Sparc microprocessor, which it licensed from Sun Microsystems Inc. in August, and develop a family of Unix-based workstations that are optimized for doing symbolic, or AI, computing. TI will move its existing AI software tools and applications, which currently run on its Explorer and microExplorer workstations, onto the new platform. And it will continue efforts to develop vertical market applications in areas where the company has already had success, such as airline operations and manufacturing.

TI hopes that its new hardware will solve a problem that has dogged its AI business for the last several years: the fact that the market for AI computers has moved away from specialized AI platforms (or LISP machines), toward general-purpose Unix workstations, such as those offered by Sun. By the mid-1980s, AI customers began to discover that they no longer needed special-purpose AI machines to run their applications; they could use a conventional Unix workstation and run a full catalog of Unix applications as well.

The Lisp machine market has dried up, and will shrink to $161 million in 1989, from $173 million in 1987, according to Dataquest Inc. of San Jose. The AI industry has seen Lisp machine makers such as Lisp Machines Inc. and Symbolics Inc. hit the skids, and TI has watched sales of its Explorer reach no more than a dribble.

TI reports that it had sold only 2,000 of the $40,000 to $50,000 Explorers by the end of 1987, a poor showing for three years of sales. And many of these were sold to other divisions within TI. The company is doing better with its new $20,000 microExplorer, introduced last March. The microExplorer uses an Apple

Computer Inc. Macintosh II with an add-in board incorporating TI's custom-developed Lisp microprocessor, and gives a good amount of AI computing power at a low cost. TI expects to sell somewhere between 1,000 and 5,000 microExplorers in its first year.

**Firm commitment to AI**

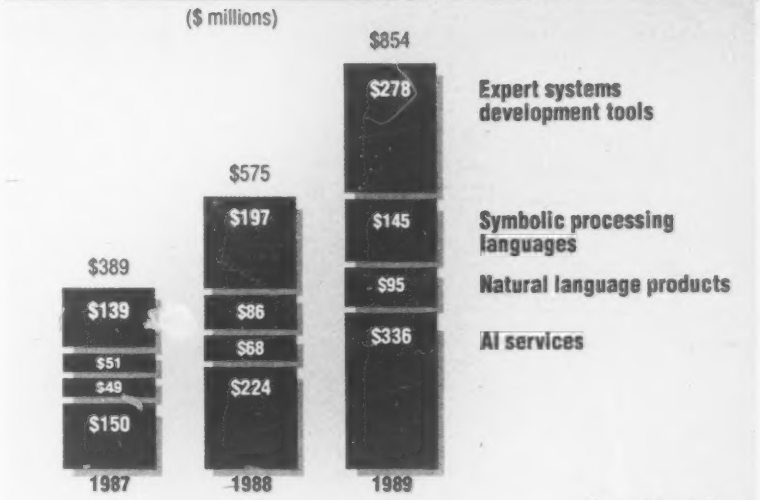
But the sales boost from microExplorer is unlikely to offset declining sales of Explorers and sluggish sales of software, according to Sarah Spang, editor of the Manchester, Massachusetts-based newsletter, *Spang Robinson Report on Artificial Intelligence*. Spang thinks that TI's revenue from AI hardware, software and services will remain flat in 1988 and 1989, and she guesses that this figure will be around $35 million. TI, although it would not release any numbers on its AI sales, acknowledges that figure is in the ball park. Peter Van Cuylenburg, vice president of TI's Data Systems Group, adds that the firm's standalone AI operation has lost money.

These losses, asserts Susan Messenheimer, a consultant with Natick, Massachusetts-based AIM Consulting & Publications, are what caused TI to retrench last June. TI transferred close to 100 employees to other parts of the company and folded its Advanced Systems Group, the AI operation, into its Data Systems Group.

But Van Cuylenburg claims that the merger of the two groups six months ago was not a retrenchment and signifies no wavering commitment to AI. This, he says, was merely part of TI's strategy to integrate its AI technology into general-purpose, commercial systems, whose responsibility belongs to the Data Systems Group. Van Cuylenburg points to a spate of new software products introduced recently and explains that the transfer of personnel was necessary in order to eliminate redundant positions. "Any time you put two P&L entities together you have redundancy," he says.

Regardless of the reasons for what will result in a reduction in personnel expense, TI still faces considerable costs in producing its new Sparc-based system, due out within two years. TI will be building several architectural features found on its Lisp chip into the new Sparc system, such as memory management, essential to

**Worldwide AI revenue for non-hardware products**




Source: Dataquest Inc.

AI computing and not currently available with Sparc. In addition to making operating system changes, TI must convert its software tools to the new platform. TI would not release numbers on its projected development expenditures, but says it will continue to invest heavily in its AI effort.

This new investment is clearly a gamble. Although TI's hardware offerings will be more in line with the wishes of the market, the company will be entering a bloody battleground — the market for Unix workstations. "They'll be competing in a market that's already very difficult to compete in," says AIM's Messenheimer.

**Despite not yet having turned a profit, TI remains committed to its AI investment**

Hopefully, software will save the day. TI has a substantial amount — some 30 megabytes — of system software that will be transferred to the Sparc system. This will create what TI expects to be the most comprehensive AI environment available. Besides incorporating various tools and utilities for development with Lisp, TI will extend the new system to the increasingly popular C++ language. Since the new system will be used for conventional, non-AI computing as well, TI will integrate its popular computer-aided software engineering tools, which currently run on an IBM mainframe, into the new system.

TI's strategy of focusing on what it calls "operations management applications" may also prove beneficial to the company. Many of the manufacturing applications were first developed inside TI's own manufacturing areas. This strategy may allow TI to establish a lock on markets with large potential systems volumes.

The general consensus among industry observers is that TI will eventually reap a reward from its investment in AI, as expert systems are deployed throughout the business world in the 1990s. "I think they are going to be long-term players," says Kenneth Sonenclar, president of South Norwalk, Connecticut-based AI market researcher, Newscience Associates Inc. Adds Spang of the Spang Robinson Report: "Basically, they've got the money to survive."

But precisely when TI's reward from AI will occur is anyone's guess. One thing is certain, at least from TI's perspective. It won't occur a moment too soon.

MICHAEL R. LEIBOWITZ

COMEBACK COMPANY OF THE YEAR

*The editors of ELECTRONIC BUSINESS have selected General Signal Corp.'s GCA division as the "Comeback Company of the Year"*

# Fighting back

BY RICK WHITING

Peter J. Simone used to box in college, but he was hardly prepared for the semiconductor industry slump of 1985 which hit GCA Corp. like a knockout punch. For awhile, the wafer stepper company, which has since been purchased by General Signal Corp., looked like it might be down for the count.

"I can think of two or three times where we were minutes away from Chapter 11," recalls Simone, then a vice president and now president of the firm. In 1985, the company — which the previous year had controlled 19% of a stepper market then estimated to be $967 million — recorded a net loss of over $145 million, and defaulted on payments to its creditors and suppliers.

Both analysts and current GCA executives largely agree on the factors that led to the company's free-fall: too rapid diversification; the use of debt rather than equity to fuel growth; the failure in 1984 to heed the warning signals of a downturn the following year; and too much focus on product technology rather than on customer needs.

But, from all appearances, GCA now seems to finally have its house in order. The Andover, Mass., company has streamlined its organization and has tried to focus on its core business: wafer exposure lithography.

Although General Signal does not disclose financial results for its operating units, GCA, before it was formally acquired, did report a modest profit last spring of $1.2 million (not including a gain of $215,000 for a tax loss carryforward), its first black ink in nearly three years. GCA, too, says it continues to be profitable, although it won't say by how much.

VLSI Research Inc., an independent market research firm in San Jose, projects that GCA will capture 13% of the estimated $940 million wafer stepper market for 1988 — for about $122 million in sales. That's up from 6% market share last year, when the company did $80.2 million in sales. Shearson, Lehman, Hutton Inc. analyst Stephen Balog estimates that for 1988, GCA will record net income of $8 million on sales of $140 million.

In recent months, too, GCA has been winning orders for its Model 8500 DSW Wafer Stepper —including one from Motorola Inc. with a value of some $8.4 million; and its ALS laser-based system, which began shipping this year, is likewise said to be winning acceptance in the semiconductor community.

Customers that have remained loyal to GCA through the bad times — and there were some very bad

Renee Fraser

**In the dark days of 1985-86, GCA president Peter Simone says that bankruptcy was a constant threat**

**John Halter, Simone's boss at General Signal, says GCA is committed to an aggressive R&D program**

times — say they did so for somewhat selfish reasons: they had an installed base of machines to protect, and they would like to have people from GCA around for service and support. But customers also told ELECTRONIC BUSINESS — which selected GCA as this year's *Comeback Company of the Year*, that they believe in the company and its products. They also emphasize the need for a U.S.-based wafer stepper company.

**Customer support**

"We need companies like GCA to survive and even thrive to be competitive with Japan," says Gil F. Amelio, president of Rockwell International Corp.'s Rockwell Communications Systems unit, and supervisor of that company's semiconductor operations. Since the early 1980s, Japanese companies such as Nikon and Canon Inc. have grabbed large shares of the worldwide wafer stepper market. Amelio, a longtime GCA customer, maintains that from a semiconductor industry point of view, it is advantageous to have a domestic wafer stepper manufacturer such as GCA.

Amelio admits, however, that "our whole factory is based on their products. There was self-interest there." As a result, Rockwell continued to purchase equipment from GCA during the bad years of 1985-1987, even though Amelio admits being nervous about GCA's chances for survival.

But the need to defend an American presence in the global semiconductor equipment market was a compelling factor. "On a selfish basis, we should support the hometown boys before turning to other companies from outside," agrees Raphael Klein, president of Xicor Inc. in Milpitas, Calif. He calls the purchase of a GCA product "a strategic investment" for his company and others like it.

"GCA has been our supplier of systems for some years," Klein says. Xicor has an installed base of nine GCA systems and ordered two more in September. "We continuously bought from them, despite their difficulties. We had confidence in them."

Other companies echo Klein's sentiments. Jim Echols, wafer fabrication operations manager for Motorola, says his company stuck by GCA because of the extensive user training GCA offered, the easy-to-maintain systems and quick availability of spare parts. "I don't think we've ever had a bad taste in our mouths from dealing with GCA," Echols says. "When it came time to upgrade, there was never any doubt in our mind who we were going to go with."

**Turnaround signs**

The first signs of a turnaround actually came last May. After nearly three years of red ink, GCA reported a first quarter operating profit of nearly $1.2 million. Then, in June, General Signal completed its acquisition of the firm for $49.6 million, providing a badly needed capital infusion.

Those results are in marked contrast to GCA's showing for the previous three years. "They were just bleeding red ink all over the place," Dan Hutcheson, president of VLSI Research, recalls. "They were the prime example of how not to run a semiconductor equipment company."

Industry watchers say that in the years leading up to the slowdown, GCA may have alienated its customers by focusing more on product technology than on user needs. As an example, Hutcheson cites one incident from the early 1980s when NEC Corp. came shopping for a wafer stepper and asked for a custom system. When GCA said no, the chip maker turned to Nikon, which provided NEC with the equipment it wanted.

Simone provides his own example. He says GCA once devoted much of its development resources to shrinking the footprint of a new wafer developer system with a large potential customer in mind. "But in reality, we probably should have put more [ef-

Marvin Cooke

fort] into reliability," Simone says, in retrospect. The targeted customer eventually bought another system from a competitor.

"We were the experts," Simone acknowledges of GCA's attitude. He says the company failed to understand that once customers take possession of a system, "then *they* become the experts. Because remember, they now understand your product, plus they know the process to which they are applying the product. And I don't think we reacted well to the information coming back."

Not surprisingly, customer confidence began to erode. A 1987 VLSI Research survey of GCA customers showed that 16% vowed never to buy equipment from the vendor again, and, on a scale of one to 10, the survey gave GCA unimpressive scores of 6.8 for service after sale and 5.9 for technical leadership.

**Customers remained loyal to GCA because they wanted to support a U.S.-based company**

Simone says that in 1984 and 1985, the reputation of GCA's equipment was often better than the products really were. Today, he believes GCA has quality products, but the company must rebuild its reputation. "It took us time to get into trouble and it's going to take us time to get out of trouble," he says. And there are indications that GCA's efforts to improve customer relations are working. Although VLSI Research is still compiling the results of its 1988 customer survey, Hutcheson believes that GCA is no longer suffering a deterioration in customer confidence.

### Manufacturing innovations

To correct past errors, GCA is now experimenting with a variety of manufacturing techniques to ensure customer satisfaction. Today, anyone within the company can halt system shipments if there is any doubt about the product's quality, according to Simone. "Consistent product quality is the key," he says, adding that the company is beginning to see more repeat business than before.

To further improve relations with its user base, GCA has also begun holding regular meetings with its customers and, Simone believes, become more open to feedback. "We've come to the realization that the only way to really know whether you're succeeding or not is for the customer to tell you," he concludes. "If you're evaluating yourself, you're not going to get an objective opinion."

"They are learning to think more from the customer point of view," agrees Rockwell's Amelio.

GCA also made a strategic decision to continue investing in research and development, despite its financial woes. Both Simone and John E. Halter, vice president for operations at General Signal, to whom Simone reports, believe that GCA's decision to invest heavily in R&D was a major factor in the company's survival.

The funding was necessary to develop the line of excimer laser-based steppers on which the company is gambling its future. The systems marked a change in direction from the X-ray technology-based products being produced by its competitors.

Some of its R&D funds have also gone into upgrading existing systems. GCA had been experiencing problems with its Model 6000 DSW Wafer Stepper series. Although Simone considers the systems to have been technologically worthy, he says they were time-consuming to set up and test and were difficult to adapt to individual customer applications.

To improve the reputation of that product line, GCA in 1986 began shipping in volume the Model 8000 DSW Wafer Stepper series, described by Simone as "our first really solid systems." Today, such customers as Klein at Xicor applaud the systems as easily upgradable.

### Need for stability

Under General Signal, GCA also wants to reduce the management turnover which contributed to the company's downward spiral during 1985-86. "We needed some outside people, but I think we made too many top management changes. I think that's one of the reasons we lost our way," according to what Simone says. Also echoing that same belief is Jim Echols at Motorola. "It just seemed to me that they were going through a lot of personnel changes at the high levels and some continuity

## A chronology

**Mid-1985:** Wafer-stepper maker GCA Corp. suddenly faces a financial crunch when the semiconductor equipment industry is hit with a sudden downturn. By the end of the year, the company will lay off 830 workers, consolidate its operations and sell off several divisions.

**February 1986:** Richard D. Stewart resigns as president and chief operating officer, while Milton Greenberg retires as chief executive. Director Leonard S. Sheingold briefly holds the president's post, followed by an "office of the president" made up of Peter J. Simone, John H. Bruning, and Louis F. Bieck, who is supervising international operations. The same month, lenders plan to accelerate loan repayment schedules, possibly triggering a bankruptcy filing. Simone talks creditors into granting "a stay of execution."

**March 1986:** Richard P. Rifenburgh is appointed chairman and chief executive.

**February 1987:** Simone is named president.

**April 1987:** GCA undergoes a major financial restructuring, called "a private Chapter 11" by one analyst. Rifenburgh departs.

**July 1987:** GCA names David R.A. Steadman, president of a Raytheon Co. venture investments division, to serve as chairman and chief executive. GCA begins to see signs of an upturn when third-quarter order backlog is more than double that of the second quarter.

**October 1987:** GCA's plans for a public offering are thwarted by the stock market crash. Negotiations to be acquired by General Signal Corp. begin.

**March 1988:** General Signal agrees to pay $5.22 a share or $49.6 million for GCA. The acquisition takes place in June.

was lost," according to Echols.

As the 1985 semiconductor equipment slump neared, other actions — or inactions — by GCA's top management helped set the stage for the company's decline. Rapid expansion and diversification, continued production, high levels of debt, and "a management that had its head in the sand [and] didn't see it coming was the recipe for disaster," says Bang.

GCA had grown rapidly and the company's top management did not believe the good times would come to an end, according to Eberstadt Fleming Venture Capital analyst Timothy J. Allen. "That was not seeing the handwriting on the wall when it was pretty damn clear," he says.

"There was this overwhelming view that we were in a business that just couldn't turn down," says John H. Bruning, then a vice president, and today GCA executive vice president, chief technical officer and president of its Tropel industrial lens division. "And when the signals for the downturn in 1985 came along, they were just regarded as nonsense."

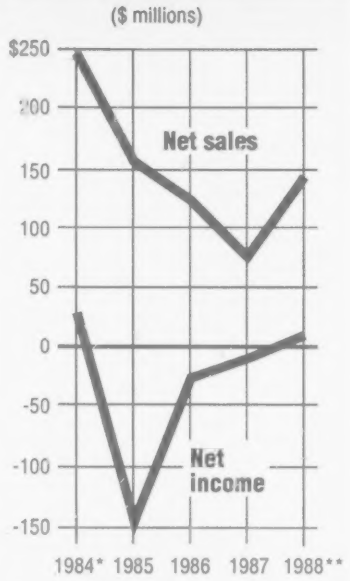
But Richard D. Stewart, GCA's president and chief operating officer between 1984 and 1986, says the company continued to receive orders for production equipment despite growing indications of a slowdown in the semiconductor market. On that basis, he says GCA maintained its production levels.

"It was our view that the chip industry was continuing to build plants" and expand production in expectation of long-term growth, he says. It was not until several large orders, reportedly from AT&T, Hitachi Ltd. and others were canceled, that the slump hit home.

Currently chief executive and president of Computer Corp. of America in Cambridge, Mass., Stewart says he resigned his GCA posts because of "a combination of things," but chiefly the opportunity offered by the CCA job. Currently in retirement in Tucson, Ariz., former GCA chairman and chief executive Milton Greenberg declined to comment for this story.

GCA was rapidly diversifying into such areas as robotics and scientific instruments "when it should have been squirreling away money for a rainy day," Bruning recalls. Just before the slump, GCA had even begun site preparation work for a $40 million optics development and manufacturing facility in Rochester, N.Y.

**GCA's turnaround**




* 1984 restated to separate results of continuing operations from those of discontinued operations

** Shearson, Lehman, Hutton estimates

Sources: GCA Corp., Shearson, Lehman, Hutton Inc.

"I think that one of the fundamental problems we had was that we were trying to diversify and grow at the same time, and we just didn't have the infrastructure," Simone says.

GCA's vertically integrated manufacturing made it more difficult to rein in expenses when the slump came, according to Hutcheson. Another problem was the company's bloated army of research and development engineers, which the analyst says were unable to get new products out the door.

### Increased competition

Simone also argues that the company was facing increasing competition from Nikon, Canon and other Japanese wafer stepper equipment manufacturers. But Hutcheson believes the inroads made on GCA's turf by the Japanese companies were more a result — rather than a cause — of the U.S. company's decline. As a result of this, a weakened GCA gave the Japanese vendors the opening they needed to gain market share.

When the downturn actually hit in the summer of 1985, Simone, then in charge of GCA's international operations, was on a trip to China. He returned to find the company suddenly on the financial brink. "Once the mistake was made of building for this huge demand that was expected in 1985, and then funding that with debt, there was no way to react," he says.

While a bankruptcy filing might have been the quickest way to buy time for the struggling GCA, Simone believed the cost in lost customer confidence would be too high. "It was important that we do our damndest to stay out of Chapter 11," he says. "I felt that with a Chapter 11 scenario, we just couldn't sell $1 million pieces of equipment requiring a high level of support."

GCA immediately consolidated its manufacturing, administrative, and R&D operations into the Andover plant and vacated leased facilities in Massachusetts, Illinois and Minnesota, totaling some 500,000 square feet. In September, the company's vacuum metals processing division was sold and plans were made to sell off the factory automation and scientific and analytical equipment divisions in 1986.

By the end of 1985, the company had slashed its payroll by idling 830 employees in three waves of layoffs. Combined with the sold-off divisions and another 180 workers laid off in October 1986, GCA's total employment, once as high as 3,500, today stands at around 1,100.

GCA's management never promised its employees that each layoff would be the last, according to Simone. "If there is a lesson to be learned, it is that you're better off telling them the absolute blatant truth." GCA even paid its workers a week in advance to avoid delayed paychecks in the event of a sudden bankruptcy filing.

GCA's financial juggling act would continue throughout the year of 1986. Simone recalls one instance in February when the company's lenders said they were accelerating loan repayment schedules — a move that could have triggered a bankruptcy filing. "I can remember personally asking them to hold off," he says, "and they gave us a stay of execution." In

April, the board of directors all resigned when the company could no longer afford their liability insurance premiums.

**Fat trimming**

Hutcheson says that turnaround expert Richard P. Rifenburgh, named GCA chief executive on March 15, 1986, and later appointed president, was critical in overseeing the company's relationships with its creditors and providing the financial management the ailing company needed in 1986 and early 1987. (Rifenburgh left GCA in April of 1987 and was succeeded as chairman and chief executive by David R.A. Steadman, president of Raytheon Co. venture investments division. Steadman left after the acquisition by General Signal.)

**Despite the turnaround, Simone is still keeping a wary eye on the economy**

But Hutcheson also says Simone, Bruning, and other GCA veterans provided continuity and ensured that only the company's fat — and not its heart — was trimmed during the consolidation. Simone credits his management team with helping to bring about GCA's turnaround.

In April 1987, GCA restructured its finances by renegotiating its debts to its lenders, a consortium of 14 banks and insurance companies, and received an infusion of cash through a rights offering underwritten by The Hallwood Group Inc. financial services firm. GCA renegotiated debts with its suppliers, including Digital Equipment Corp., Hewlett-Packard Co., IBM and other small companies. As with GCA's lenders, the vendors had to accept about 50 cents on the dollar for the outstanding debts.

Simone recalls that at one critical point during the financial negotiations, Rifenburgh was on the phone trying to convince a holdout creditor to accept the restructuring plan. At the same time, some of GCA's biggest customers, invited to hear details of the restructuring, were waiting in another part of the company's headquarters. Had Rifenburgh's efforts failed, the customers might have heard an announcement that GCA was filing for bankruptcy.

The bridge financing GCA obtained in the April 1987 restructuring was intended to hold the company until a planned public offering in October. But like a fighter struck with one last blow before the bell, the stock market crash came on the eve of the public offering. Shortly thereafter, General Signal proposed a buyout and the deal was struck in March 1988. "The turnaround was pretty much in place by the time General Signal bought them," Hutcheson says. "I think they would have survived," agrees analyst Allen, but he believes the company would have had difficulty financing its capital needs had it not been acquired.

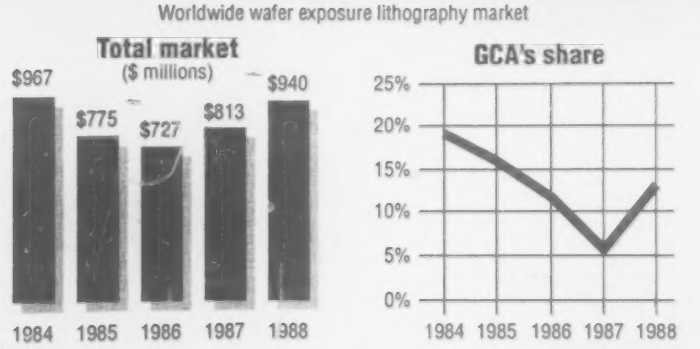
General Signal's Halter believes that the acquisition has helped GCA overcome credibility problems due to the company's "shaky financial situation." GCA is part of General Signal's Semiconductor Equipment Group, as is Ultratech Stepper of San Jose, another wafer stepper systems vendor. While GCA and other General Signal units may share technology or other resources, Halter says GCA will remain fairly autonomous under its parent company.

But Simone says that GCA is not completely out of the woods, noting that the cyclical semiconductor business has made chip manufacturers cautious about capital spending. Unlike the boom years before 1985, when systems were ordered in large numbers far in advance, customers today generally place small orders with leadtimes of only 90 to 120 days. "We're making money. But these are good times. We should be making more," he laments. Analysts' predictions of slower growth for semiconductor production equipment vendors in 1989 add more clouds to GCA's horizon.

"We're fighting a time and credibility battle to get ourselves back into competition," agrees Bruning. "I think teetering on the edge of bankruptcy for a few years is a very humbling experience." □

## GCA starts to rebuild its market share

Worldwide wafer exposure lithography market




Source: VLSI Research Inc.

## The decision

### How we chose the *Comeback Company of the Year*

After an informal survey of independent analysts and leading figures in the electronics industry, GCA Corp. was selected by the editors of ELECTRONIC BUSINESS as *Comeback Company of the Year.*

Under extraordinarily difficult conditions, GCA's management team — which included both past and current executives —staunched a three-year flow of red ink and brought the company back from the brink of financial disaster.

GCA accomplished this task through discipline and considerable sacrifice at both the management and staff levels. ELECTRONIC BUSINESS applauds GCA — and its parent company General Signal Corp. — for its remarkable achievement.

AL FURST

# Shopping spree: Foreign firms expand in the U.S.

*The cheap dollar has made U.S. expansion a bargain. And fears of protectionism have made growth here a high priority for overseas firms*

BY RAY WISE

Foreign electronics companies are rapidly expanding their shares of the U.S. market. (On the following pages, ELECTRONIC BUSINESS ranks the top foreign companies in the United States.) Overseas firms are not only selling more here, they are manufacturing more as well. Indeed, the strength of many currencies against the depressed dollar is prompting foreign companies to acquire — or expand their own — businesses here at a bargain price.

"Japan and the United Kingdom have been particularly active, but they are not the only countries involved," according to Alex Ladias, research manager for the Chicago-based merger consulting firm of W.T. Grimm & Co. Ladias figures that 151 U.S. mergers and acquisitions were announced by foreign companies in the first half of 1988, sharply higher than the 99 such transactions in the year-earlier period. More than a dozen U.S. electronics firms, or parts of them, have been acquired by overseas buyers since early 1987, Ladias estimates. France's Thomson-CSF, of course, acquired the consumer products division of General Electric Co. And Siemens AG bought a 60% stake in Telecom Plus International, a communications concern based in Long Island City, N.Y.

For the Japanese, in particular, U.S. expansion results partly from their growing fears of protectionism and partly from their move into more sophisticated industrial electronics. "If they sell a product locally, they want to make it locally," says Bill Ebsworth, portfolio manager of the Fidelity Pacific Basin Fund. Foreign firms aren't just buying existing businesses, they're shopping for new sites and plants as well.

Hitachi America Ltd., Tarrytown, N.Y., makes a wide range of products in the United States, including computers and telecommunications equipment. It even exports disk drives from its Norman, Okla., facility to Europe. "One of our strategies is to increase our manufacturing base in the U.S.," says Harry W. McGrath Jr., deputy general manager for corporate administration.

Canon Inc. generates a third of its worldwide sales in North America, and its U.S. manufacturing output contributed to a U.S. sales gain of better than 90% in 1987. Demand runs especially high for Canon's chip-making equipment, laser printers and facsimile machines.

**Since early 1987, more than a dozen U.S. electronics firms have been acquired by overseas buyers**

Matsushita Electric Corp. of America, Secaucus, N.J., operates eight plants in the U.S. and expects to add more, according to a company spokesman. "We are still on a roll and looking to other operations," he says. Matsushita's presence in the United States dates back to 1974, when it acquired the consumer products division of Motorola Inc. and its Quasar brand name. In the past five years, it has added components, car speakers, cellular mobile telephones, pagers and VCRs. Workers at a new Atlanta facility are turning out electronic point-of-sales systems. Factories under construction in Troy and Columbus, Ohio, will manufacture CRTs and (in partnership with Eastman Kodak Co.) consumer batteries.

The steep drop of the dollar from a high of ¥260 to ¥120 put expensive price tags on Japanese-made products sold in the United States and served as a strong incentive to expand U.S. manufacturing. Yet, plans by some Japanese electronics concerns were laid years before the big currency move began in 1985. "If the dollar had not dropped, maybe we would now have only four or five U.S. plants," says the Matsushita spokesman. "The yen situation only served to accelerate the process."

Japan doesn't have a monopoly on the make-it-where-you-sell-it strategy. In fact, this approach is strongly espoused by N.V. Philips GL, the Dutch electronics giant with the largest presence here. Sales in the United States account for 20% to 30% of the company's total revenue. And Philips intends to increase its stake to the 40% to 50% range, concentrating on components, consumer electronics and information technology. "Philips has a policy of raising its local manufacturing resources to the level of its local sales," says Albert Ruttner, a vice president in Philips' New York City office.

Japan is moving especially fast, however. Its push away from a complete focus on mass-produced consumer electronics into more sophisticated high-end industrial products requires a production presence in the countries where they are sold. "Once you introduce new technology, you bring in a new set of problems and you have to be close to your customers," agrees Roger A. Schwantes, vice president for product tehnological development in the Nashville, Tenn., office of Canada's Northern Telecom Inc.

Clearly, the Japanese move into the U.S. industrial electronics market

Roger Roth

will entail technological development, and the stakes go beyond the enhanced profitability that is attainable with higher end products. Robert E. Johnson, technology analyst specializing in Japanese companies for Swiss Bank Corp., points out that the gradual shift will help Japan maintain its competitive edge over South Korea and the other fast-growing, newly industrialized countries (NICs) of the Pacific Basin.

The emerging competition apparently is beginning to figure in the long-term strategies of the big Japanese electronics outfits. "Their focus for the future is on industrial electronics. They realize this is where the growth is, and where there is more value added" says Johnson. And Laura Luckyn-Malone, portfolio manager of the Japan Fund, New York City, agrees: "This is the trend, and there is no going back."

Japanese firms realize that sustaining the trend will require creativity, the portfolio manager says. "There is a definite shift in Japan toward becoming a major technological innovator," says Luckyn-Malone, and some of the R&D will be transplanted to the United States. The basic research for Hitachi America now is done in Japan, but there are plans to phase it into the United States over the next five years.

The absence of a major Japanese research presence in the United States is blamed by some analysts for some big mistakes made by the country's electronics industry, in particular, missing the boat on the personal computer. "If you weren't here, you couldn't participate in the development of the PC," adds Johnson.

**Selective threat**

Japan's manufacturing and research beachhead in the United States is being built on a very small base — the annual revenue of IBM alone is more than three times the aggregate U.S. sales of the seven Japanese electronics companies with the largest stake here. And analysts see the competitive threat posed to U.S. companies as being highly selective. The U.S. electronics industry is expected to retain dominance in non-memory chips, software, high-end and low-end hardware and chemical process chip-making equipment, according to Johnson. Yet, he sees the Japanese looming large in the optical technologies — laser printers, optical storage devices and optical readers.

While the Japanese electronics companies reserve their worst fears of protectionism for the United States, they also are looking to 1992, when the restructuring of the European economic community into a single marketplace is scheduled to take place. So a manufacturing buildup in Europe is also likely, according to Fidelity's Ebsworth. "The Japanese want to get in before the gate is closed."

As if to underscore this incipient globalization, Matsushita in October announced a realignment of its corporate structure along global lines. The main Osaka office will direct operations in Japan as one of four management headquarters; the Secaucus office will oversee North American, South American and Latin American operations; Europe and Africa will be the under the jurisdiction of London headquarters; and there will be an Asia-Middle East headquarters at a site not yet selected. "The aim is to make each region as self-sustaining as possible," says a spokesman.

The long-range globalization of the Japanese electronics industry will vary in scope and speed from company to company and will not necessarily be easy, according to Johnson. So far, he says, Japanese executives haven't excelled at working with people of other cultures. Explains Johnson: "They are used to a monocultural environment." □

## Top foreign companies in the U.S.

| Rank | Company | U.S. electronics sales ($ millions) 1987 | 1986 | 1987 total consolidated sales ($ millions) | 1987 profit before taxes ($ millions) | Fiscal year ended | Country of origin |
|---|---|---|---|---|---|---|---|
| 1 | Philips | $5,300 | $3,993 | $25,968 | $501 | 12/87 | Netherlands |
| 2 | Matsushita | 4,300 | 3,700 | 34,839 | 3,117 | 3/88 | Japan |
| 3 | Northern Telecom | 3,103 | 2,860 | 4,854 | 449 | 12/87 | Canada |
| 4 | Sony | 3,081 | 2,634 | 10,347 | 531 | 3/88 | Japan |
| 5 | Toshiba | 2,880 | 2,000 | 25,827 | 907 | 3/88 | Japan |
| 6 | Hitachi | 2,811 | 3,030 | 35,967 | 2,394 | 3/88 | Japan |
| 7 | NEC | 2,300 | 1,948 | 19,626 | 507 | 3/88 | Japan |
| 8 | Canon | 2,194 | 1,150 | 6,753 | 278 | 12/87 | Japan |
| 9 | Siemens | 1,910 | 1,500 | 27,503 | 1,390 | 9/87 | West Germany |
| 10 | Sharp | 1,800 | 1,600 | 8,857 | 312 | 3/88 | Japan |
| 11 | Fujitsu | 1,570 | 1,170 | 14,797 | 848 | 3/88 | Japan |
| 12 | Mitsubishi | 1,200 | 1,200 | 14,435 | 261 | 3/87 | Japan |
| 13 | CGE | 1,200 | 865 | 21,208 | 744 | 12/87 | France |
| 14 | GEC | 1,122 | 1,100 | 9,457 | 1,206 | 3/88 | Britain |
| 15 | Sanyo | 1,120 | 1,200 | 8,046 | 4 | 11/87 | Japan |
| 16 | Samsung Electronics | 1,048 | 800 | 2,882 | 55 | 12/87 | Korea |
| 17 | Thomson-CSF | 800 | 425 | 5,970 | 619 | 12/87 | France |
| 18 | Olivetti | 653 | 835 | 5,688 | 415 | 12/87 | Italy |
| 19 | Bayer | 600 | 370 | 20,635 | 1,703 | 12/87 | West Germany |
| 20 | C. Itoh | 500 | 500 | 101,112 | 152 | 3/87 | Japan |
| 21 | Kyocera | 554 | 542 | 2,172 | 364 | 3/88 | Japan |
| 22 | Lex Services | 539 | 442 | 2,360 | 77 | 12/87 | Britain |
| 23 | TDK | 524 | 450 | 2,701 | 284 | 11/87 | Japan |
| 24 | Pioneer Electronic | 517 | 470 | 2,424 | 160 | 9/87 | Japan |
| 25 | Racal | 500 | 475 | 2,328 | 235 | 3/88 | Britain |
| 26 | Schlumberger | 480 | 450 | 4,727 | 619 | 12/87 | Netherlands |
| 27 | Thorn EMI | 477 | 430 | 5,201 | 384 | 3/88 | Britain |
| 28 | Lucky-Goldstar | 443 | 398 | 14,422 | NA | 12/87 | Korea |
| 29 | Oki Electric | 437 | 460 | 3,263 | 76 | 3/88 | Japan |
| 30 | Ericsson | 413 | 400 | 5,102 | 174 | 12/87 | Sweden |
| 31 | Alps | 325 | 325 | 2,532 | 98 | 3/87 | Japan |
| 32 | Daewoo | 350 | NA | 18,000 | NA | 12/87 | Korea |
| 33 | Plessey | 309 | 280 | 2,216 | 293 | 3/88 | Britain |
| 34 | Casio | 300 | NA | 1,430 | 47 | 3/87 | Japan |
| 35 | Ciba-Geigy | 248 | NA | 10,580 | NA | 12/87 | Switzerland |
| 36 | Commodore | 223 | 230 | 871 | 68 | 6/88 | Bahamas |
| 37 | Bosch | 201 | 180 | 14,091 | 966 | 12/87 | West Germany |
| 38 | Brother Industries | 198 | 185 | 1,129 | 83 | 11/87 | Japan |
| 39 | Hanson | 171 | NA | 10,409 | 1,154 | 9/87 | Britain |
| 40 | Ferranti | 158 | 97 | 1,400 | 116 | 3/88 | Britain |

U.S. electronics sales are ELECTRONIC BUSINESS' estimates. All figures are converted at the exchange rates for the latest fiscal years, thus a variety of accounting and exchange rates are represented.

Source: ELECTRONIC BUSINESS

# Can fierce Winchester competitors become partners?

*Maxtor's George Scalise wants U.S. drive makers to form a consortium to counter the Japanese. His biggest problem may be convincing his counterparts that it's necessary*

BY MICHAEL R. LEIBOWITZ

It's hard to imagine executives of the fiercely competitive United States Winchester disk drive industry sitting together in the same room, much less shaking hands and agreeing to form a consortium. Yet if George Scalise, former chip industry executive and Maxtor Corp. president gets his way, the United States drive industry will do just that.

As the force behind an effort to form an industry consortium, Scalise wants drive makers to set aside their differences to do such things as fund university R&D and lobby Washington on trade issues. Although the precise objectives of the consortium were still fuzzy when Scalise initiated a meeting of 25 drive makers at an industry convention in September, the overall objective, he says, was clear: U.S. drive makers must band together to guarantee their future health.

With research in important disk drive technologies shifting from the United States to other countries — notably Japan — Scalise says, the drive industry here can no longer be complacent about retaining its leadership. Not only must drive builders begin to pool R&D resources to counter this trend, he continues, but they must make Washington aware of their strategic importance. With the support of Washington, the industry can do such things as influence trade legislation to its benefit, and perhaps, win R&D tax credits to help fund new research.

By the end of the meeting, Scalise had already won the support of several executives. CEOs of three companies: Finis Conner of Conner Peripherals Inc.; Lawrence Perlman of Imprimis Technology Inc.; and Stuart Mabon of Micropolis Corp.; agreed to join Scalise in forming a subcommittee to propose a specific agenda for the future consortium.

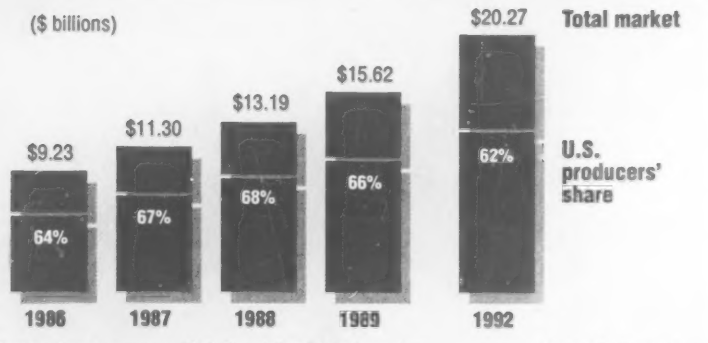
But others are either opposed or undecided. "I personally don't think that Seagate would want to belong to it," says Al Shugart, chairman of the leading Winchester drive maker. Says another CEO, who asked not to be identified, "It seems to me that this is a solution looking for a problem. There isn't a real cause on which to rally at the moment."

**Borrowed strategy**

In proposing the consortium, Scalise is borrowing a strategy that he helped develop during his 29-year tenure in the semiconductor industry. Specifically, he hopes to unite U.S. competitors to counter Japan Inc. As chairman of the Semiconductor Industries Association (SIA) public policy committee, Scalise helped plan and win passage of such landmark legislation as the U.S.-Japan Semiconductor Trade Agreement, intended to eliminate Japanese chip dumping. He was involved in three R&D consortiums designed to counter the Japanese threat — as a cofounder and director of the Microelectronics and Computer Technology Corp. (MCC), as chairman of the Semiconductor Research Corp., and as one of the early planners of Sematech.

But grafting the semiconductor industry's successful formula onto the drive industry may be difficult, according to some experts. While the U.S. semiconductor industry could point to markets that it had lost to the Japanese, the drive industry cannot. In fact, the U.S. drive industry commands 67% of the worldwide market in terms of revenue, a number which has actually risen in the past five years, according to Phil Devin, an analyst with Dataquest Inc. of San Jose. As it turns out, U.S. disk drive makers' keenest competitors

**Worldwide market for Winchester drives**




Based on factory revenue, not including retail or distribution markup

Source: Dataquest Inc.

**Some in the industry question the need for a consortium, since the U.S. disk drive industry controls about 67% of the worldwide market**

are other American suppliers, not the Japanese.

But the United States can lose its lead, warns Scalise and his supporters. They contend that not enough research is being done in fundamental technologies such as magnetics and electro-optics to assure the industry's future innovations. Perlman of Imprimis points to a 1985 National Academy of Sciences study that showed that the United States is falling behind Japan in magnetics research, a technology important to disk drives. Says Perlman: "When we have a large magnetics conference in the United States, we have trouble finding enough Americans to evaluate the papers contributed."

Conner, meanwhile, complains that the U.S. drive industry is dependent on Japan, which supplies most of the drive heads, disks and motors used in Winchester drives. "We've got to find ways to stimulate development and manufacturing of those products here in the United States," says Conner. Unless this happens, he contends, "the whole industry is at risk."

Conner would like to see the consortium lobby Washington for R&D tax credits for conducting fundamental research, especially in view of the government support given foreign competitors. The government hinders innovation, according to Conner. "In our first year of production, we paid over 40% in taxes. That's ludicrous."

Scalise supports a tax credit effort, but cautions that this is too big an issue to tackle alone. "You have to generate a much broader constituency for that," he says. A more realistic early goal for the consortium, he says, will be to concentrate on influencing international trade legislation. One of the first items on the agenda might be to remove Winchester drives from the list of products that are subject to export documentation under the trade bill passed this year. The group may establish a monitoring program to identify other legislation that could affect the industry.

In R&D, Scalise says that he would like the consortium to start off by funding university research at such centers as Carnegie Mellon University and the University of California, San Diego. "The example here is Semiconductor Research Corp.," says Scalise, referring to the organization that supports university-level research from funds provided by semiconductor and equipment makers. Later on, he says, he would like to form a Sematech-like venture that performs joint R&D.

### Consensus lacking

But before any of this can happen, Scalise has to develop a compelling plan that will win the support of the other drive makers — companies with vastly different interests and needs. Given the current slump in business, disk drive makers are not in the mood to spend great amounts of money on programs that appear to be of questionable use.

**Maxtor president George Scalise would like to fund disk drive research with a Sematech-like venture**

If the consortium funds university research, for example, it risks losing the support of potential members such as Al Shugart of Seagate and Joseph T. Rodgers, chief financial officer of Quantum Corp. Shugart believes that his company can derive the most benefit from university research by funding this itself, which it already does. Quantum's Rodgers does not want to contribute to research, preferring to leave this to his component suppliers.

The idea of lobbying Washington appears to have more support from drive makers, who recall the successful effort that Scalise led recently to get import tariffs removed from drives assembled overseas. "An individual company can't put a lot of input into the lawmaking process," explains Seagate's Shugart, who lists lobbying as "the only thing that would cause me to consider joining a consortium."

Quantum's Rodgers is also in favor of uniting the industry to influence legislation. But he wonders whether a major lobbying effort is necessary, given the absence of specific issues right now. Instead, Rodgers says that a better plan would be that proposed by Censtor Corp. chairman, Ed Zschau at the September meeting: Maintain a mailing list of members and bring them together when there is specific legislation that needs attention. At that time, funding can be raised and lobbying begun.

It is quite unlikely that the consortium will win everybody's support. And although it might be nice to have everyone's support in a lobbying effort, it is not vital, according to David Yoffie, an associate professor at the Harvard Business School and expert on business-government relations. But nonmembers cannot actively oppose the lobbying agenda. "That undermines any action," according to Yoffie.

To be effective in lobbying Washington, the consortium will need money and a substantial commitment of time by certain members. Yoffie pegs the cost for a full-time Washington lobbyist, office and secretary at $1 million. More expensive is the time required of key executives and managers in order to visit congressmen and bureaucrats. The lobbying effort cannot succeed without the participation of industry executives, stresses Yoffie.

Although it may be small by legislative standards, the U.S. disk drive industry does have one advantage in its future lobbying efforts: George Scalise's Washington contacts, cultivated during his years as a semiconductor activist. "It took him a long time to build access to high-level people," says Yoffie. "And all of that effort will not have to be replicated."

But before winning the concessions from Washington, George Scalise and his subcommittee will have to convince his fellow disk drive makers to join them. Given the conflicting interests and objectives of disk drive makers, this may be his toughest challenge of all. □

# Lifetime costs edge out MIPS in sales pitches

*"Cost of ownership" is the new computer marketing watchword as hardware prices fall below 30% of total system costs*

BY CAMILA CHAVES CORTES

Look at the full-page auto ads in your Sunday newspaper; the sticker prices always jump out in bold type. Check out the test-drive data in the car magazines and you're sure to see the zero-to-60 mph times prominently listed too.

It used to be that way with big computers. Fifteen years ago, system purchases were based on price, and vendors' marketing strategies involved little more than quotes that came in under the competition's. A decade ago, vendors shifted tactics some, pitching the performance that users would get for their dollar.

But increasingly, savvy computer customers are forcing those old notions to change. It's no longer enough to peddle dhrystones and MIPS; today the emphasis is on lifetime costs. With good reason: at least one market researcher indicates that hardware costs (for hardware used exclusively for network interfacing) can be as little as 25% of the cost of computer-network ownership over five years.

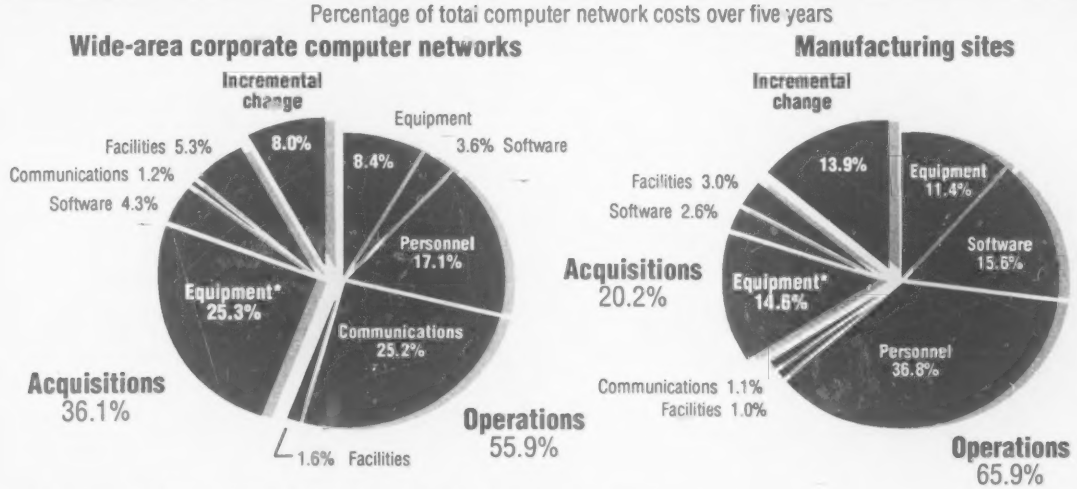
Consequently, big computer makers like Digital Equipment Corp., Hewlett-Packard Co., IBM and Wang Laboratories Inc. are tailoring their marketing strategies to talk cost of ownership (CO). Says Rene Martinez, manager of financial marketing in DEC's U.S. sales support group: "We would like to make CO the way to see the cost of computing." And Herb Oscher, director of product marketing at Data General Corp., confirms that he will continue to use CO studies as his major marketing strategy: "For 1988 and 1989, we plan our CO to be 20% to 40% below our competitors' during a five-year period," he says.

CO means taking into account the cost of staffing the computers; the cost of running the physical facilities — the computer rooms with their heating and ventilating and power needs; the network communications costs; the maintenance charges; and even the cost of fax facilities and voice processing.

The issue is a hot one as the market for midrange computers tightens, forcing vendors into fiercer competition. Market watchers at Wall Street investment brokerage First Boston Corp. point to zero domestic growth in the minicomputer sector, and not much more than 10% internationally for next year; and for 1989, net in-

## Equipment purchase is only a fraction of total computer cost-of-ownership

Percentage of total computer network costs over five years




* Equipment includes only computer hardware or portions thereof, dedicated to networking

Source: Index Group Inc.

come is expected to dip to 9.6% of sales even for industry powerhouse Digital Equipment Corp., according to First Boston.

And lifetime cost is more topical as it becomes apparent that staffing payroll and network charges are a growing proportion of total CO. The Sierra Group, a Tempe, Arizona-based market researcher, points out that as hardware prices — acquisition, maintenance charges, minus the expected residual at the end of the equipment's useful life — come down, the future maintenance costs are as significant as buying the machine today.

There's some evidence to suggest that CO feedback may prove valuable to vendors too, isolating cost spikes that can be relayed back to production teams or software development engineers. It is invaluable as input for product pricing, too. But one aspect is clear: it can cost plenty to find and pitch CO advantages.

Wang, which aims to compete with DEC and IBM on initial price-performance and on CO over three years, takes its CO studies seriously. After data-crunching through what-if analyses, the company puts about 150 of the involved employees together to work out CO.

Wang then devotes a team of six or seven people, plus some systems people, to develop the CO picture based on internal costs and the desired profitability. Then the team factors in competitive pricing data and matches it to its costs to arrive at a conclusion the marketing people can live with.

But CO is by no means the perfect yardstick. "The cost of computing is not really known; it's a big mystery. We are finding that a lot of the CO in a system has been hidden because very few accounting methods take all the factors into consideration," admits DEC's Martinez. It gets tricky when data centers, telecommunications facilities and voice-systems departments all have different budgets. And it's tough to make apples-to-apples comparisons of computers when a DEC VAX might be working a database while an IBM System 36 tackles spreadsheets, and when operating systems remain so diverse.

And vendors can still tilt the figures in their favor. "You will see different CO studies come out from vendors based upon their strength," according to Lane Nonenberg, Hewlett-Packard's vice president for support.

A lot of CO data comes from comparative studies done on contract by researchers like the Sierra Group or the Cambridge, Massachusetts-based Index Group. A custom report prepared early this year for DEC by another researcher, Computer Economics Inc. of Carlsbad, Calif., showed — not surprisingly — that typical midrange DEC models such as the VAX 11/785 and VAX 8200 required an average of 2.6 fewer staff to run each year than IBM machines such as the 4331, 4341 and System/38s — a potential cost gap of almost $75,000 annually. Too few of Big Blue's new 9370 sites were operational to be included in the study.

In another report, the Sierra Group addresses IBM's June 1988 cuts in software pricing for the 9370, pointing out that those cuts could trim up to 12% off the cost of operation of a 9370 over five years.

**Computer vendors can still tilt the cost-of-ownership data in their favor**

But many computer vendors supplement the market researchers' findings with their own studies. Wang, for instance, uses the Sierra Group reports, and Wang performs additional competitive analysis and validations of its data to obtain results that are as timely as possible. At Texas Instruments Inc., it's the same story: the company's computer-systems operation factors in data from the industry watchers, but relies heavily on its own analyses of competitors' pricing structures. Says Wendell Harrison, director of industry marketing: "By the time you get your hands on a market research report, your competitors would have a product out."

### Distorted pricing

TI's Harrison raises an interesting issue: how to define CO when different channels of distribution can distort pricing. The more value the VARs add to the computer system, the more difficult it becomes for the computer manufacturer to figure the CO. Says Harrison: "We can't tell our resellers what they should sell their product for, and what price the market will bear."

Some computer executives see more scrutiny of the number of staff it takes to make a computer network work. In the future, says HP's Nonenberg, "One will see staffing as a significant part of CO because the cost of staffing is going up and the price of machines is coming down." Some claim that day is already here: a study by the Index Group shows personnel costs as high as 36% of lifetime operating costs for computer networks in manufacturing sites.

The report prepared by Computer Economics for DEC claims that operating systems have considerable sway in staffing levels. It maintains that while IBM sites using DOS/VSE require only 30% more staff than comparable DEC VAX/VME sites, those using IBM's MVS/XA system could call for over six times the staff. For many users, that's a price they're prepared to pay in return for the sophisticated I/O and memory management capabilities offered by MVS, and for the flexibility to handle complex environments like multiple databases or on-line transaction processing that the IBM operating systems offer.

Traditionally, IBM in most cases charges more for hardware, and in some cases, for software; but less for maintenance and support. Digital's strategy is low hardware prices, but higher charges for maintenance and support. DEC recently displayed that tendency by requiring customers to pay for a previously free one-year warranty program, a move that could add the equivalent of 6% to 9% of the computer's purchase price to total systems costs.

But the perception picked up by computer-industry analysts is that DEC's action represents a 6% to 9% price increase — and in the real world, where psychology plays just as important a role as rational fact, perception counts. While the computer vendors' use of CO as a marketing tool may bring new information to potential buyers, it's also creating a bit more confusion. Concedes one computer marketing chief: "CO analysis will not force anyone to buy from us or from someone else; it is just another way of comparing data." □

# Taking the wraps off

## The technologies of the 1990s

Imagine that you are in your office when the phone rings. On the other end is your Japanese joint venture partner calling from the company's manufacturing facility in Osaka, Japan. The call is urgent. A glitch in a plant floor controller is holding up the day's production. But there is another problem, a seemingly insurmountable one. Your Japanese caller speaks just enough English to convey the immediacy of the situation but not enough to highlight its details. And you speak just enough Japanese to buy a newspaper in downtown Tokyo.

What do you do? Go down the hall to get that engineer you sent to Osaka last year to set up the plant operation? Grab your Japanese-English dictionary? Or, worse yet, ask for a call back when the problem is solved?

By the year 2000, technology permitting, you may not have a dilemma. You may be able to speak English into your phone while your Japanese caller listens in Japanese. It all depends upon a number of technologies, including speech recognition which enables a computer to act upon the input of speech in the same way it reacts to commands typed into a keyboard.

On the way to a translating telephone, though, speech recognition and evolving technologies like it will find commercial applications. Sometime in the 1990s, industry experts concur, commercially available microprocessors will be capable of 100 million instructions per second (MIPS); desktop computers running several hundred MIPS will be sold for under $10,000; and floppy disks will be as small as one inch in diameter.

Within the next decade, three-dimensional ICs and superconductors may step out of the research labs into the marketplace; voice-and-data communications links based on the Integrated Services Digital Network standard (ISDN) and X-ray lithography for IC production may become commonplace, according to a survey conducted by ELECTRONIC BUSINESS (see accompanying story).

The survey asked 1,500 heads of R&D and engineering in electronics companies what they consider to be the emerging technologies that will make a significant commercial contribution to the electronics industry in the years 1995 to 2000. Over 423 responded; in the semiconductor category, 67% put their money on optical circuitry; in materials, superconductors got three-quarters of the respondents' votes; and in computer peripherals, over 82% ticked erasable optical disk drives.

Today, a lot of R&D muscle is behind the push to bring such technologies to market tomorrow. According to

Greg Couch

BY ANNE KNOWLES

the National Science Foundation. U.S. electronics firms spent over $20 billion on R&D in 1986. According to ELECTRONIC BUSINESS, the top 100 R&D spenders in the electronics industry accounted for $13 billion of that, and for $15.8 billion in R&D expenditures last year. [ELECTRONIC BUSINESS, Sept. 1, 1988, p62.] On the average, electronics firms spent 8.6% of their revenue on R&D.

Deciding which of tomorrow's technologies to back is a critical step for the vice president for R&D helping to give his or her company the edge into the next decade. For example, too many resources devoted to, say, superconductivity research, may dull a computer firm's technology advantage in vertical magnetic recording. Top-notch R&D is crucial for "us to be a global competitor and manufacturer and for the U.S. to maintain its standard of living," says Gene Connor, vice president for manufacturing and technology at Advanced Micro Devices Inc., which spent a phenomenal 24.9% of revenue on R&D last year.

But Connor and others question how effectively R&D dollars are spent in the United States. Connor is concerned that not enough emphasis is placed on development and the quick turnaround of "usable and salable products." Richard A. Reynolds, director of the defense sciences office at the Defense Advanced Research Project Agency (DARPA), says that in material research, for example, the Japanese effort is much larger than in the United States. In addition, says Reynolds, "in Japan about 90% of R&D is industry R&D and about 10% is done at universities. In the U.S., probably the exact opposite is true." That implies, says Reynolds, that the fruits of Japanese R&D are transferred to the commercial market quicker than in the United States.

So, what is the solution? Opinions differ. According to Kumar Patel, executive director of the research, material science, engineering and academic affairs division of AT&T's Bell Laboratories, large institutions clearly have the most advantages. He points out that the R&D competition — Japan's Fujitsu Ltd., Hitachi Ltd. and others — is gigantic. "If large institutions [in the United States] are not able to provide the innovation we need, we will not succeed," Patel states flatly. Start-ups, says Patel, sometimes drain large R&D labs of their best talent. "While we don't want to squelch the frontier type of mentality here in the U.S., we also don't want to sap the energy of large institutions."

One solution used by Xerox Corp., which spent $722 million on R&D last year and is well-known for its research facilities, is to spin out some of its R&D efforts into start-ups. Xerox has spun off six such companies, five of which they have an equity interest in. "The scuttlebutt in the industry," concedes Patel, "is that their approach seems to be working."

Others, like AMD's Connor, think that suppliers and customers will need to cooperate in development more in the coming decade. Some think that Sematech, the recently organized semiconductor industry consortium, and joint efforts like it may be the answer. "Will Sematech and other consortiums work?" asks William J. Spencer, vice president, corporate research group at Xerox. It is hard to predict, says Spencer, "but they are absolutely neccessary in order for us to compete with Japan."

Money and man power, though, do not always guarantee results. Some technologies will advance if enough elbow grease is applied to them. Others, like neural network computers and software, require new ways of thinking that money cannot buy. The seed for those, experts warn, may come from one or two brilliant minds.

"Real conceptual advances," says Bell Labs' Patel, "come from an individual's brain."

### The next decade

Expected breakthroughs in superconductivity, for example, are difficult to pin down. The NSF estimates that the United States and Japan com-

## Electronics industry R&D funding

Industrial R&D spending by Standard Industrial Classification codes* for the latest available year — 1986 ($ millions)

| | Total | Government funded |
|---|---|---|
| **Electronic components including semiconductors** (SIC 367) | $2,537 | $520 |
| **Office and computing equipment including peripherals** (SIC 357) | $6,876 | $1,152 ** |
| **Communications equipment** (SIC 366) | $5,155 | $3,593 |
| **Total** | **$14,568** | **$5,265** |

* The National Science Foundation (NSF) does not break out spending on software. Software R&D is included in each of the equipment categories to which it applies.

** Government funded industrial R&D for office computing equipment is a NSF approximation. The NSF survey reported $1,536 million in government funded industrial R&D for SIC 35, which includes equipment other than computers and peripherals.

Source: National Science Foundation

bined are currently spending over $500 million a year on superconductivity R&D. Industry heavyweights like Bell Labs and IBM in the United States and Hitachi and Matsushita Electric Industrial Co. in Japan, and universities on both sides of the Pacific are together devoting nearly 2,000 engineers to the problem. And while many believe a breakthrough in high-temperature superconductors will occur within the next decade, others are not so sure. "It depends upon what the physics tell us," says Ray Waddoups, Motorola Inc. vice president and director of research and development at the company's government electronics group. "The physics have not been sufficiently defined to tell us what the technology will do."

The topic of advanced computer architectures is another area in which experts tread with caution. Parallel processors — computers that tie together hundreds and even thousands of processors that work in unison — are being built today. "But the difficult problem," says Bell Labs' Patel, "is [creating] the appropriate algorithms that can write a language to take advantage of parallel processing." The technology, says Patel, "is still lacking a concept that allows us to think very differently than one process at a time."

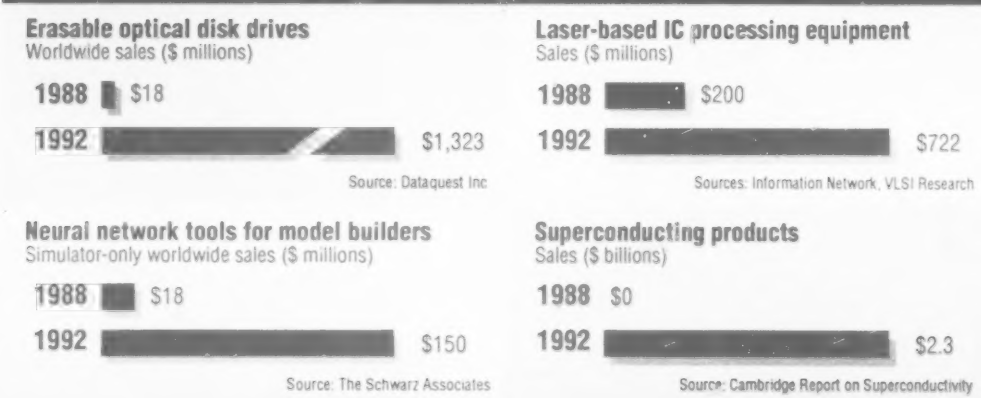
Neural network computers, designed in some way to mimic the biological brain, are suffering from the same problem. Today neural networks are hard-wired through trial and error, says Patel, because we still don't understand how they work. But their expertise at certain specific problems makes neural network computers very appealing. They are proficient at what Patel calls optimization problems — like image and voice recognition — for which the goal is to get the best, not the exact, answer quickly.

Industry researchers are understandably wary of predicting the future. "If you say there is no hope, no one will fund your research," says Stewart D. Personick, assistant vice president for the network technology research laboratory at Bell Communications Research Inc. (Bellcore). "And if you hype it and say it will happen on January 1, 2013, they'll put it on their calendar and come after you."

Despite their disclaimers, experts say some technology development is a sure bet. Most observers agree, for example, that existing semiconductor technology still needs to mature. "There is still a lot of evolutionary development needed in mainstream semiconductors like CMOS," says AMD's Connor. He predicts that by the mid-1990s CMOS devices with .5-micron line widths will be produced in volume. And by the end of the decade, says Connor, 0.35-micron ICs will be available. Work in bipolar technology will be ongoing, says Connor, but it will be "squeezed on one end by gallium arsenide when that becomes more cost effective and by CMOS on the other end."

Gallium arsenide (GaAs) ICs will continue to evolve and become used widely in a few applications. But GaAs will be limited to niche applications, says Connor, due to manufacturing and cost issues. He says today GaAs is produced on 4-inch wafers and researchers are investigating a 5-inch variety, whereas CMOS and bipolar technology are already being done on 6-inch and, at IBM,

## A sampling of future technology markets



on 8-inch wafers.

In addition, warns Motorola's Waddoups, budget cutbacks at the Department of Defense, which he says is the driving force behind GaAs research, could slow the progress made in that technology.

Because of those factors, and the general purpose nature of existing semiconductor technology, "silicon ICs will continue to dominate," says Xerox's Spencer. "There is another decade-and-a-half of milk in that cow."

**Seeing is believing**

Optical chips are still a daydream. Optical interconnection within a computer will occur on varying levels, says Joseph W. Goodman, chairman of the electrical engineering department at Stanford University. The most difficult, and furthest out along a technological timeline, is gate-to-gate optical interconnect. "Prospects within this century are very dim," says Goodman. More realizable, within the next 10 years, may be board-to-board optical connections.

Least likely anytime soon, however, is an all-optical digital computer. Replacing all of a machine's electronics with optics, says Goodman, "is furthest from reality." Others are more optimistic; 39.9% of the survey respondents believed optical computers were feasible sometime in the 1990s.

**"Real conceptual advances come from an individual's brain"**

**Kumar Patel of Bell Labs**

Goodman notes that two industry giants — AT&T and IBM — have decidedly different views on optics. And, contends Goodman, both companies are right. IBM, which sees little future in optics, is correct from its own business viewpoint; general purpose optical computers are unlikely. AT&T, on the other hand, supports optics because of its potential in communications systems.

Bell Labs' Patel expects a boon in such systems. "Within the next 10 years," says Patel, "all switching will be done in optical. The cost of switch-to-switch goes down as the speed goes up."

Probably the most eye-catching optical technology, though, is optical memory. Goodman says that while Japanese stalwarts like Olympus Optical Co. Ltd. and Sony Corp. have done a lot of work in that area, the United States has competitive product. The 30-millisecond access time on Maxtor Corp.'s Tahiti 1 erasable optical disk is faster than Japanese products by a factor of two. It is also capable of holding up to a gigabyte —or 300 volumes of 1,200 pages each — of data.

While the Japanese are gearing up to produce digital audio tape (DAT) in high volume, political issues here in the United States may continue to stand in the technology's way, says Don Lundell, corporate vice president for engineering at Cipher Data Products Inc., a major U.S. tape-drive maker. "DAT is a product whose time has come," says Lundell. It's a high-volume product geared for the low end of the market. But the U.S. record industry is trying to thwart attempts to sell it here because of its ability to reproduce CD ROM without degradation. And the personal computer peripheral market is a much smaller market without the high-capacity needs provided by DAT.

According to Lundell, the auto industry may be deciding DAT's future here, if it chooses to include DAT recorders in its next-generation cars. Ford Motor Co., for example, is currently testing DAT players in its 1988 Lincoln Continentals.

**Workgroup computing**

All this capacity, bandwidth and power, in addition to a lot of software, will create a desktop very different from today's. Winchester disk drives will use 2.5-inch form factors and laser printers will be available for $200, projects Lundell; desktop computers costing $10,000 will process data at hundreds of MIPS, predicts Xerox's Spencer.

Artificial intelligence, in the form of expert systems, will be increasingly used in common applications, observers agree. This, and brawny hardware, will create what Xerox's Spencer calls "knowledge robots," — friendly computers a user can program daily to do database searches and other tasks.

But most importantly, most of those high-speed desktop machines will be networked together. "In less than 10 years, the number of networked PCs will double," claims Lundell.

Powerful hardware and robust multitasking operating systems, like OS/2 and versions of Unix, will drive software development. Software will take advantage of that brawn in a number of stages, says Edward J. Belove, vice president, corporate research and development at Lotus Development Corp. First, Belove believes existing applications, like Lotus' 1-2-3 spreadsheet, will become more functional. Next, software from different vendors will be integrated and "connected to one another in seamless ways." In turn, packages will talk to one another, says Belove, and vendors will cooperate in their integration.

The third stage, and most formidable goal, will be the creation of workgroup computing. Belove calls it "groupware." It is a step beyond communal word processing. It will entail application packages designed to work on networked PCs that enable groups of people to work together. And, again, it will demand new, as-yet-unknown ways of thinking and working. □

nologies Inc., San Jose, in July 1986, based on the company's strategy of designing ASICs for microcomputers and letting somebody else fabricate them. "Two years ago, it was thought that you had to have your own fabrication line," says Stephen G. Woodsum, managing director of Summit Ventures. Despite having bucked this conventional wisdom, Chips eventually went public and in the fiscal year ended June 30, 1988, reported earnings of $1.54 a share, up sharply from the year-earlier $1.01.

Crucial to selecting a technology to back, venture capitalists agree, is accurately assessing the state of the competition. According to Mike Shanahan, a partner in Eastech Management Co., Boston, even a truly innovative technology has "functional competitors" who accomplish the same thing by entirely different means, which is why the price performance of a new technology is critical.

Almost universally stressed by venture capitalists is that judging technology entails evaluating the people behind it. "We do a lot of checks on the folks in the company to establish what work they have done in the past that is related to what they are doing now," reports DuBose Montgomery, partner in Menlo Ventures, Menlo Park. Sequoia Capital backed Convex Computer Corp., a minisupercomputer maker, partly because "The people all had stellar backgrounds; they had designed machines that worked, and they had four-star resumes," according to Moritz.

Pavey prefers entrepreneurs willing to regard the venture capitalist as a partner who will participate in strategic decision-making. "We don't want to control the company, but we do want to be a partner, and if we don't think that relationship is possible, we don't put up the money."

RAY WISE

# The changing face of technology in the 1990s

*Our readers pick which new technologies will likely develop into commercial products in the 1990s*

Believe it or not, it's nearly 1990. The next decade, like the last, promises to change the face of technology in the electronics industry. What evolutionary, revolutionary and plain old amazing technological achievements will occur in the next 10 years? ELECTRONIC BUSINESS surveyed 1,500 vice presidents and directors of technology, engineering and research and development to get a picture of what tomorrow will look like. Respondents listed what they believed to be the most likely technologies that would develop into commercial products in the 1990s.

## ELECTRONIC BUSINESS technology survey

What new technologies will likely develop into commercial products from 1995 to 2000? — Percentage of respondents*

### Semiconductors

| | |
|---|---|
| 67.1% | Optical semiconductors |
| 47.2% | Wafer scale integration |
| 41.5% | 3-D integrated circuits |

### Materials

| | |
|---|---|
| 74.0% | Superconductors |
| 43.3% | Submicron photoresists |
| 37.9% | Polymers with low dielectric and high temperature |

### Computers

| | |
|---|---|
| 77.2% | Parallel processing computers |
| 39.9% | Optical computers |
| 36.1% | Neural network computers |

### Capital equipment

| | |
|---|---|
| 63.1% | Laser-assisted production |
| 55.7% | Mixed analog/ digital testers |
| 33.0% | X-ray lithography |

### Peripherals

| | |
|---|---|
| 82.3% | Erasable optical disks |
| 64.2% | Speech recognition |
| 22.1% | Vertical magnetic recording |

### Software

| | |
|---|---|
| 63.4% | Advanced compilers |
| 63.4% | Real-time operating systems |
| 42.9% | Object oriented programming |

* Multiple responses

Source: ELECTRONIC BUSINESS

# How do venture firms pick a winner? Carefully

*They may be attracted to a new technology, but that's not all venture firms will judge a start-up on*

The decision to fund a start-up based on its technology is a chancy, complex process that warrants a hefty payback when a winner is picked, venture capitalists say.

The cycle of true innovation that began with the creation of the integrated circuit, progressed to the microprocessor and culminated in the emergence of the microcomputer "made more money for venture capitalists than any other technological wave in history," according to Bob Pavey, a partner in Cleveland-based Morgenthaler Venture and a director of the National Venture Capital Association. Profits generally are substantial when a venture capital firm finances the right company, and, in fact, the investment can appreciate as much as tenfold over five to seven years if it is injected at the start-up stage.

The bumper returns reflect the intricacy and risk of evaluating a technology's potential. "We spend hours upon hours talking to scientists, planning how to harness their technologies to marketable products," says Nissan Boury, managing director of Warburg Pincus Ventures, New York City.

These investors rarely judge a technology unaided, although they screen ideas that are presented to them. Business proposals that pass through this initial gauge are then evaluated with the help of experts outside the venture capital firm.

"We do not hope to understand leading-edge technologies," says Diana H. Frazier, vice president of BancBoston Ventures Inc., a wholly owned subsidiary of Bank of Boston.

Even with outside help, deciding whether to finance technology is "a great, big step into the deep, dark unknown," according to Michael Moritz, a partner in Sequoia Capital, Menlo Park, Calif. "We have to find out how different the proposed technology is from others that are, or will be, available. Only if it is well differentiated will our blood pressure go up."

David S. Lobel, partner in First Century Partners, New York City, etches a sharp distinction between improvements to existing products and technology that creates a whole new class of products, as Apple Computer Inc. accomplished with its microcomputer. Lobel steers clear of "better mousetraps," unless, he says, "the management team is truly superb, because everything has to go right. With true innovation, we have more time and will take more risk with management."

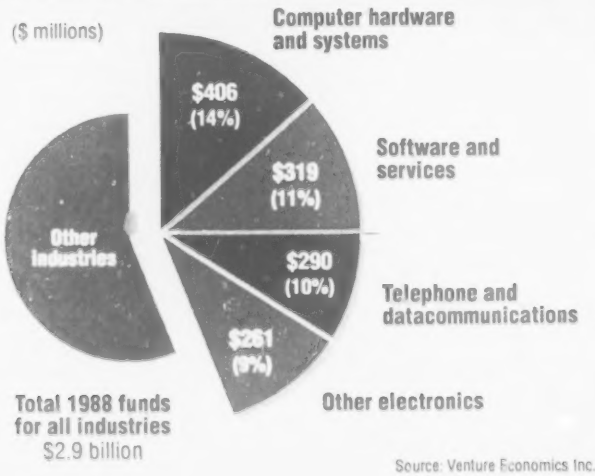
Venture capital often is infused in very early-stage technology. When Sequoia Capital invested in Ultra Network Technologies, San Jose, in December 1986, the company's "blisteringly high-speed LAN for supercomputers and near-supercomputers was still on paper," Moritz reports, and the first product was brought out only weeks ago.

In terms of putting product on the shipping dock, many venture capitalists use a two- to three-year time horizon. "I want to see a working prototype in 12 to 18 months," Lobel notes.

### Taking a flier

Sometimes the venture capitalist takes a flier on the innovative strategy of the technology's creators. Summit Ventures, Boston, backed Chips and Tech-

**High-tech start-ups attracted nearly half of venture capitalists' funds in 1987**




Source: Venture Economics Inc.

# Start-up success? It *can* be done without venture funds

*Rich aunts, big corporate partners and even Uncle Sam get plenty of new firms off to good starts — but they can't always match those old VC connections*

BY VALERIE RICE

Starting a company without venture capital used to mean it was doomed to failure. In today's market, that's no longer true.

With surprising frequency, start-up companies are finding alternate ways to finance their growth, and they are succeeding in the face of some of the biggest odds.

For budding entrepreneurs either too stubborn or too far ahead of their time to go the venture capital route, the road is rocky, but the payoffs can be big.

Roughly 25% of the 150 semiconductor companies started in the last 10 years have not used venture capital funding, according to a survey done by market research firm Dataquest Inc. This trend is not just limited to semiconductors; high-technology companies from software to peripherals are also looking for different options.

From foreign stock markets to the federal government to corporate partners, wealthy private investors and even customers, alternate financing opportunities have multiplied over the past few years. Although venture funding has not disappeared, it is more difficult to get, making nontraditional funding sources even more attractive.

Citing "control of our destiny" as the biggest reason for bypassing venture capital, executives at companies such as California Micro Devices Inc., Cumulus Technology Corp., International CMOS Technology Inc., Orbit Semiconductor Inc., Pantronix Corp. and even "old-timer" Siliconix Inc., entered the market without the venture seal of approval, and actually prospered.

But one doesn't scoff at conventional wisdom without a price, and funding a company without the deep pockets of a venture capitalist brings its own share of heartache.

Christopher Springmann

**On a Rolls: Rejected by several VCs, California Micro Devices' chairman Chan Desaigoudar used a funding strategy that gives him 51% of his company**

### Nothing ventured, something lost

When companies forgo venture funding, what do they give up?

In the most simplistic terms, big name venture capital spells p-r-e-s-t-i-g-e.

Venture capitalists provide management experience, a financial safety net, and perhaps even most importantly, contacts. If a company receives money from one of the top five high-tech funds, it also nets some reflected glory, basking in the glow of an L.J. Sevin or a Fred Adler.

And, although prestige is an intangible, to those who have benefited from it, it is quite real.

Consider the case of Cypress Semiconductor's founder T.J. Rodgers, an acknowledged venture cheerleader. Although Rodgers has an MBA from Stanford University, he claims his venture people have kept him from making numerous bad decisions.

Just being connected with these top-flight venture people has had its own rewards — like staying out of court. Cypress, which is swamped with legal battles today, could have been overwhelmed by legal battles

when it began, and Rodgers says only the connections of venture capitalist L.J. Sevin and his team of lawyers kept him out of five major lawsuits over the past few years. On the basis of recommendations from the same venture firm, Cypress received the largest loan Bank of America ever made to a start-up — $9 million.

These are advantages it is hard to disregard, as California Micro Devices Inc.'s chairman Chan Desaigoudar would agree. During his first rocky year of bootstrap financing, Desaigoudar hit a period where he was $30,000 short for payroll, and had to go to a customer to borrow the money against future product. He made payroll then, and has taken the company from virtually nothing to an estimated $120 million at the end of this year.

Desaigoudar acknowledges, however, that his perceived lack of backing has done him some damage in the marketplace, and that his company does lose sales to competition purely on that basis.

Other start-ups hit the venture capital wall when trying to find enough money to invest in future growth. Chip start-up Macronix Inc. is now considering bringing venture capitalists into the company for the first time because the money to expand operations just doesn't exist, according to president Paul Lui. "We want to grow our business in the United States," he says. "We need more money. We can't get enough profit to grow to the next stage."

Executives at Cumulus Technology acknowledge the risks, but believe that venture capital is unnecessary for them. "There is a limit to the amount of cash we can get," admits finance vice president Peter Henderson. "As long as we are at the mercy of the vagaries of the market, that may stunt our growth."

But sometimes, when things go sour in the market, the only answer is venture capital, at least for Unix software house Unify Corp., Sacramento, Calif. Although Unify began life with private funding, it lost its way as the Unix market fragmented, says president David Saykally, and venture funds were the only option. The advantages of management guidance and connections far outweigh the disadvantages, he says.

Despite the downsides, some executives would rather risk falling flat on their faces than give away the majority of their company for very little money today.

### Controlling destiny

"Profit is the motive," declares Desaigoudar, of his decision to privately fund his semiconductor company. "If I make a mistake I have no one to blame but myself."

Stanley Wang, founder and president of Pantronix Corp., a test, assembly and packaging house, says that his route of private investors has allowed him to "maintain my independence. We have no outside influences here. There is no pressure to compromise. With a venture capitalist, 100% growth is too slow. This way we can maintain control."

Chips and Technologies Inc. president and chief executive Gordon Campbell says that if he had gone the venture route (he claims to have been vetoed by 60 VCs), "... we would own less of the company and not have as much control." Campbell so values the control factor that he considered a leveraged buyout of Chips to take the company private again. Even though right now he says "it would be a mistake to reposition us," he has not forgotten the skeptical reception the market gave him.

Although most of these maverick executives would argue that no price was too high to stay free of the clutches of the "vulture capitalists," there are trade-offs to be made, depending on the funding source. Although generally speaking, founders of privately funded start-ups do better financially than those at a venture start-up, even that is not always true. Essentially, there is no free financing out there, only greater or lesser evils.

Corporate partnering is a popular solution to the funding dilemma, and one in which every party can be a winner. Cypress is the sole investor in bipolar start-up Aspen Technologies Inc., and according to Rodgers, it is a mutually agreeable relationship, in which Cypress gets technology access and Aspen can get management help.

But the relationship must be synergistic, warns Siliconix president Richard Lee. Siliconix's major shareholder is Westinghouse Corp., which has been trying to sell its shares in the company now for several years.

Christopher Springmann

**Chips chief Gordon Campbell says clowning around with venture capital would have cost him the control he so values**

Lee says he'll "be glad when that era [the sale] is over. It's important to have happy shareholders."

Orbit Semiconductor Inc. is fully owned now by Orbit Instruments Inc., says president Gary Kennedy, because the instruments company was the only one which was interested in funding a foundry operation. Kennedy characterizes the relationship as strong, although he notes that none of the semiconductor founding team own any part of the company.

When Chips looked for funding, it ended up with a mix of private investors and money from four Japanese firms, a combination which Campbell claims was just right to get the company over the initial hurdles.

The fact that Campbell went to Asia to get funding is not surprising. Japan, in particular, has accrued a substantial surplus of capital, and has been plowing much of it into U.S. investments, notably in real estate.

Both Pantronix and Macronix have private and corporate investors from Asia, and Lui explains that money is easier to come by over there. "They don't make you jump through the hoops that you have to over here. If they like your business plan and they believe in you, they give you the money. There isn't the due diligence over there."

But the foreign money is not just in Asia. Favorable exchange rates make European money go further in the United States right now, as Cumulus Technology Corp. discovered.

Having run out of stray aunts and uncles to invest in the company, and feeling that management was experienced enough to do without VC advice, the founders went to the Vancouver brokerage market for funding and a public offering, says Henderson. Although the market over there has a "gloryhole mentality," he says, the company was fortunate in getting a longer term deal. The Vancouver connections brought introductions to the European market, and now Cumulus has some of the largest banks in the world as investors.

**25% of the 150 chip makers started in the last decade didn't use venture funding**

For a truly unusual funding story, there is none better than Desaigoudar's story of struggling to acquire a very small and unprofitable design house. Turned down by several VCs, which, he says, "couldn't see my vision or my niche," the California Micro Devices chief turned to the Small Business Administration (SBA) for a loan. "After all, I had a small business," he says. That, combined with a line of credit from Bank of America, got him going. The taste of success must be very sweet for Desaigoudar — thanks to this funding arrangement, he owns 51% of the company.

### IPOs and the FUD factor

The most difficult period in a privately funded start-up's life comes at the time of the initial public offering. Or maybe the issue might be better stated as: "To go public, or not to go public?"

With a venture funded company, that is not a question. With the connections available, and the elusive prestige factor, venture funded companies find an easy time of it, and their stock goes out at a higher price.

Yet, private companies, must struggle to get a share of the broker's mind, wind their way through the complex corridors of the Securities and Exchange Commission, and hope for enough momentum in the market to ensure a respectable stock price.

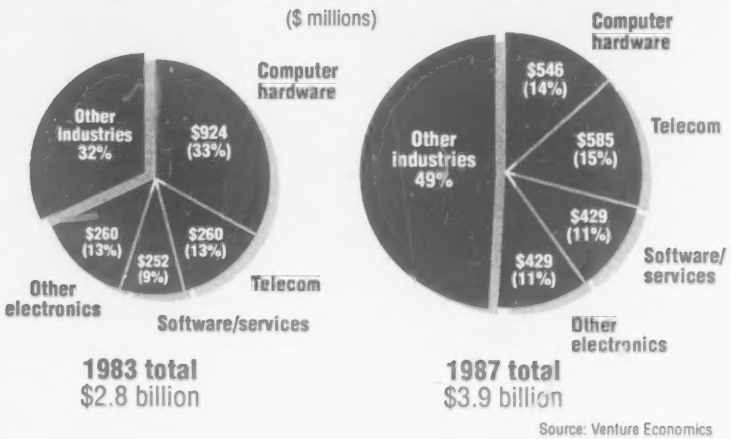
"There is some merit to having a venture capitalist in your company," Macronix's Lui allows. "They can help you to go public and can give you the insight to do it right."

Ready Systems Inc. president James Ready notes that as his company considers an IPO next year, he is grateful for his venture capitalists. "There is such a strong venture capital infrastructure, " he says. "They can network you from your inception to going public. It gives you tremendous advantages."

Campbell offers the contrarian viewpoint. He admits that Chips' initial stock price of $5 was "way undervalued" but argues that's an advantage in the bearish technology stock market that exists today. "We have never gone underwater," he claims, "and that cannot be said of [some others], which went out at higher prices."

For Wang at Pantronix, the real issue surrounding the IPO is the short-term nature of the American stock market — and of the venture community. Wang views an IPO only as a means to an end, not the end in itself, and believes that by trying to squeeze every last cent out of the company in short-term profits, the long-term health of the company will be jeopardized. □

## U.S. venture capital investments




Source: Venture Economics

**Electronics and computer companies are increasingly being forced to find alternatives to venture capital funding**

# Korean PC firms make impressive inroads here

*But as wages and the value of the won rise, profits are falling. Korean electronics giants realize that to survive they must offer more than just low prices*

BY JOHN McCREADIE

The South Korean electronics industry is still booming in the United States, and from all indications will continue to grow. Korean electronics giants are now focusing more on PC sales, hoping to make new inroads by expanding current product lines and increasing their market share in this country.

In less than two years, companies such as Daewoo, Goldstar, Hyosung, Hyundai and Samsung have grabbed increasing shares of the U.S. market. With PCs based on Intel Corp.'s 8086/88 chip, the Koreans have firmly entrenched themselves as contenders in the IBM-compatible PC arena. Korean PC exports last year jumped to $260 million from $60 million two years earlier, according to U.S. Department of Commerce figures. During the first half of 1988, the Commerce Department reports, Korea shipped $172 million worth of PCs to the United States.

InfoCorp, a market research company based in San Jose, ranks Daewoo third for 8086/88 units consumed in the United States — after IBM and Tandy Corp. Korean conglomerate Hyundai is filling the 10th slot in the U.S. market. In the worldwide arena, Daewoo now ranks eighth, according to InfoCorp's 1988 estimates. As a result of this rapid growth, Korean companies like Daewoo and Hyundai are facing serious questions on how to keep the sales ball rolling: questions concerning name recognition, marketing strategies and product support systems are at the top of their lists.

Also, concerns that a steadily appreciating Korean won could reduce American purchases of their products by making them more expensive may be keeping Korean executives awake at night. "The Korean government is expecting appreciation of about 12% to 13% [this year], but the U.S. is pressuring them to get up to 15%," says Wan Hee Kim, an expert on Korea and former chairman of the Electronic Industries Association of Korea. In addition, the United States has threatened trade sanctions if South Korea fails to open its domestic import doors wider, allowing for more trade from the West.

Traditionally, the Korean government has slapped prohibitive tariffs on imports, most notably on foreign auto imports. It's estimated that 95% of the cars on Korean roads are manufactured locally. But these restrictions have eased greatly, Kim contends. "Koreans are now willing to import technology and products from the U.S.," he says. "America is a large market and they want to keep America happy."

Despite the threat of trade sanctions, all signs indicate South Korean growth is strong in the U.S. electronics market. For example, Hyundai Electronics America recently signed an agreement to supply a line of PC systems to Software City Inc., a New Jersey-based seller of Zenith Electronics Corp. products. "Once we hit Hyundai, it was pretty much what we were looking for," says Dennis Tully, director of hardware purchasing for

Cindy Charles

**Hyundai's H.S. Shin: His company has made a "strict commitment" to focus distribution primarily on computer speciality stores**

Software City. "Their whole product line is quality machinery with a low price."

At year-end, the Samsung Group will merge its consumer and industrial operations, Samsung Electronics and Samsung Semiconductor and Telecommunications, hoping the move will make it one of the top five electronics firms in the world by 1995. And under an OEM agreement, Hyosung Computer Co. will supply a large quantity of XT and AT IBM clones to Vendex Technologies Inc. of Great Neck, N.Y.

Overall, the success of Korean IBM clones in this country has been attributed to the Koreans' ability to undersell competitors. But as wages for Korean electronics workers continue to rise rapidly — 15% to 18% this year alone — the Korean companies realize they must carve out niches, for quality along with name recognition.

"The hardest part about competing in the U.S. is building a brand name in the marketplace," says Jung Lee, Hyosung marketing director. The biggest trick for many of these companies, however, will be establishing their own identities while maintaining their OEM contract customers.

### Name recognition

The 1988 Summer Olympics gave many Korean firms a chance to make themselves known. Samsung Electronics advertised heavily during the games, highlighting efforts to make its products a household name. By 1991, the South Korean conglomerate hopes that 55% of its electronics product line will carry the Samsung name, an increase of 15% from today's exports. And Goldstar Electronics, focusing primarily on OEMs, is talking seriously about starting a brand-name line of Goldstar PCs sometime in 1989.

All the giants hope the name recognition they have in other markets will carry over into the PC arena. Hyundai, banking on the name recognition established by the success of the Excel automobile in this country, has been supplying dealers and value-added resellers with IBM-compatibles for the past year. Likewise, Goldstar Technology Inc., a subsidiary of the Lucky-Goldstar Group, the oldest Korean company in electronics, is relying heavily on its name in televisions and VCRs, as is Samsung.

But such expansion could backfire as companies introduce products that compete directly with the companies with which they have OEM agreements. Says Goldstar vice president for sales and marketing Jay H. Lim: "Most OEM customers prefer that we don't sell products with the Goldstar name." But other South Korean companies say their product line is broad enough to allow them to do both. Hyosung America, currently doing 50% OEM business and 50% with its Maxar PC line, plans to expand both areas, says Lee.

As these companies become more established and recognized in the U.S., the need for a solid distribution game plan will become crucial for their survival. Hyundai has made a "strict commitment" to focus primarily on computer speciality stores. Executives believe that their marketing strategy, selling direct to dealers and VARs, will give them greater distribution control and longevity in the market. "Our marketing decisions are made for the long term," says Hyundai's national sales manager H.S. Shin. Although Hyundai will continue with OEM agreements, such as manufacturing a workstation for Sun Microsystems Inc., they will not make any label-switching agreements, Shin says.

Cindy Charles

**Hyosung's Jung Lee: "The hardest part about competing in the United States is building a brand name in the marketplace"**

**Last year, Korean PC exports to the U.S. jumped to $260 million from $60 million in '85**

### Too soon to tell

But is Hyundai's strategy paying off? Most analysts agree that it's too early to tell. Sales in the first part of the year were strong: 6,200 PCs sold in the United States during the first quarter, and 12,400 units in the second quarter, according to Storeboard, a Dallas-based market research firm that surveys retail stores across the country. In June, Hyundai sold 6,400 of the 235,000 PCs sold nationwide, giving them a 2.7% share of the market. In July, however, they dropped to a 1.7% market share, a sharp decline of 42%. Storeboard president JoeAnn Stahel attributes this decrease to a substantial price drop in July by mass merchant competitors, Target Stores and K Mart department stores among them. "If Hyundai continues to slip, it's simply because of their market strategy," Stahel says.

Leading Edge Hardware Products Inc. of Canton, Mass., whose PCs are manufactured by Daewoo Telecommunications Company Ltd., also experienced a similar market share decline. Storeboard reports Leading Edge had a 2.2% market share in June and a 1.9% share in July. But this may not be just an isolated drop for Leading Edge. Several analysts note Leading Edge sales have taken a turn for the worse. According to market

research by International Data Corp., Leading Edge shipped 190,000 PCs into the United States during 1986 and only 140,000 in 1987.

Reasons for this drop, according to industry observers, are that many retailers are less than satisfied with Leading Edge's ability to make timely shipments, as well as their demands to have deliveries paid in cash and in advance. K.H. Lee, general manager of Daewoo Telecom in Boston, speculates that Leading Edge seems to be giving large outlets, priority shipments and not meeting the demands of the smaller retailers. "We don't like that, but we don't have any right to do anything about it," says Lee.

Leading Edge, however, says its products currently have strong sales, helped by a new program to serve better its smaller dealers. "We are selling them as fast as they can make them," says Buddy Carp, chief operating officer for Leading Edge.

Some South Korean companies have begun shielding themselves in case sales sag in their current market segments by carefully expanding their market niche. Take Hyundai, for example. It has recently begun an effort to penetrate its PCs into vertical markets and among corporate accounts. And Cordata Technologies Inc., a subsidiary of Daewoo Electronics Company Ltd., has introduced the WPC Bridge computer that will run both Apple II and IBM software, a product which they believe will give them considerable clout in the education segment of the market.

### Opportunity for distributors

One of the areas all Korean companies are paying particular attention to is product support. As wages in Korea rise, companies can no longer rely on cost factors alone to sell their products. More and more of these companies are opening avenues for distributors and dealers to get after-sales service. "As products expand, we're going to move in to reinforce and strengthen our relationship within the market channels," says Hyosung's Lee.

**The giants hope name recognition in other markets will help sell the PCs**

If their market strategies pay off, the Koreans could become even bigger players in the high-tech computer game. Korea has already produced its own supermini, through technology provided by Tolerant Systems Inc. of San Jose, for its own national market. The project was a collaboration of the Electronics and Telecommunications Research Institute of Korea and the big four —Daewoo, Goldstar, Hyundai and Samsung. Through a similar combined effort, the South Koreans have a 4-megabit DRAM geared for production early next year. More and more of these companies are reinvesting their profits into R&D, but dollar amounts for the electronics branches of these conglomerates are not available. "I can tell you we are emphasizing R&D research and it will grow in coming years," says Hyundai's Shin.

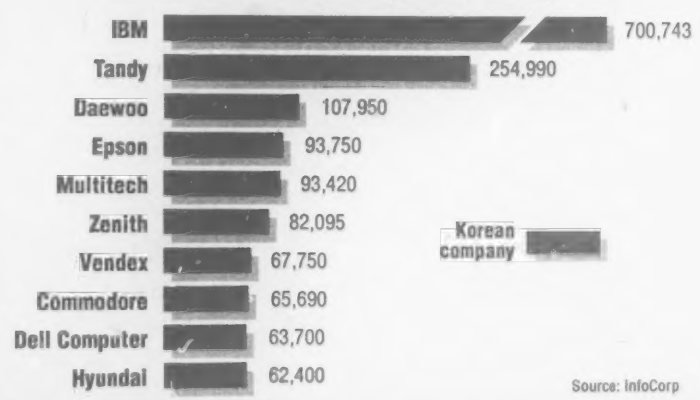
Yet the South Koreans are not limiting themselves to expansion in the United States. They have been actively increasing business with Eastern Europe and Communist countries such as China and the Soviet Union. "They have exported about $200 million worth of electronics products to these markets so far this year," says Korean electronics expert Kim. "And they expect a very large increase in trade with Communist and Third World countries."

And still more Korean electronics companies are setting up shop here in the United States. As a result of Hyundai canceling its distributor arrangements with Blue Chip Electronics of Chandler, Ariz., in order to sell its product direct to dealers, Trigem Computer Corp., another Korean conglomerate, stepped in and took over Blue Chip's manufacturing. Trigem, which formerly made models sold under Computerland's private label, now plans to diversify its products from PCs to technical workstations. Oriental Precision Co. (OPC) is now marketing a PC using the OPC name and also expanding into hard disk drive manufacturing. And South Korea's $5 billion Ssangyong conglomerate will expand on its software business and begin making PCs.

Meanwhile, as South Korean companies wrestle with the problems of being as recognizable in the United States as IBM and Tandy, they will have to deal with the same issues facing all IBM clone makers: possible lawsuits. With IBM now asking for royalties on its AT, XT and PS/2 clones, it will be interesting to see what effect this will have on Korean market strategies. Analysts say as little as 5% royalties could be devastating to South Korean PC makers because they work on such narrow profit margins. But most Korean officials are taking a wait-and-see attitude. Says Goldstar's Lim: "Probably we should talk to IBM later, but not yet." □

## U.S. consumption of low-end PCs

1988 consumption of desktop computers based on Intel's 8086/88 microprocessor (thousands of units)




Source: InfoCorp

# U.S. computer firms go shopping in Taiwan

*Just about every major computer company does its shopping in Taiwan. IBM spent $278 million there last year. Here's why*

BY PHILIP LIU

Taiwan is becoming an increasingly important source of parts for foreign computer firms. In fact, for many U.S. companies like IBM, Taiwan is now second only to Japan in terms of Asia sourcing. Cheaper prices aside, Taiwan also boasts substantial technical expertise enabling design-to-production leadtimes to be shortened by as much as one third. But quality and a lack of long-term business planning still remain major obstacles.

Taiwan's exports of information processing products — including microcomputers, disk drives, printers, terminals, keyboards, and other peripherals and components — reached $3.7 billion last year, roughly 96% of the local industry's total output, according to the Information Industry Institute. Of that $3.7 billion figure, 41% was purchased by foreign computer companies from local firms on an OEM basis. Another 39% was shipped by foreign-invested firms manufacturing in Taiwan [see accompanying chart].

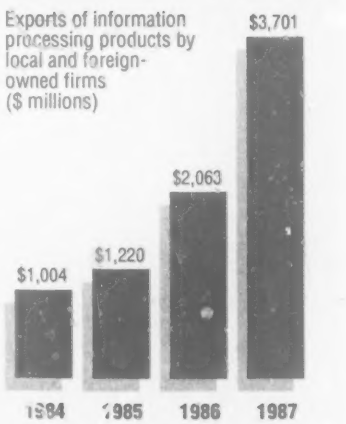
### Big Blue's shopping spree

Most leading multinational computer firms have already set up an international procurement office (IPO) in Taiwan to conduct OEM purchasing operations there. IBM, for example, established its Taiwan IPO as early as 1966 and the office is now manned by a staff of 60. Purchases have grown 20% to 30% annually in recent years, topping $278 million in 1987, virtually making IBM the biggest exporter that year. Big Blue now relies on 57 indigenous companies to fulfill its needs. Among these firms are such local luminaries as Tatung, Teco and Sampo. Some 2,100 workers are engaged in the related projects. Major purchase items are of a rather sophisticated nature, for example, plasma displays with 0.29-millimeter resolutions.

Unisys Corp. is another international firm whose IPO has been active. Purchases by the company's Taiwan IPO, which was set up four years ago, will reach $75 million this year, more than twice the 1987 figure of $31 million, according to L. S. Wu, the firm's manager. Included on its shopping list are high-performance displays, workstations, power supplies, eight-layer PCBs used in mainframes, cables, precision components for high-density disk drives, and parts for personal computers based on Intel Corp.'s 80386 microprocessors.

Also four years old, Hewlett-Packard Co.'s IPO is purchasing such items as transformers, coils, power supplies for minicomputers, die castings for disk drives, membrane switches, keyboards, PC boards, and even plastic molds, which can cost as much as several hundred thousand dollars per unit. Sken Chao, the firm's manager, refuses to reveal the figure for HP's total purchasing, but reports the amount grew 400% in 1987 and will double this year and next.

**Taiwan's exports of information products**




Source: Taiwan Information Industry Institute

### NCR spends $30 million

NCR Corp.'s IPO, established a half-decade ago, doled out some $30 million in 1987 for such items as power supplies, keyboards, eight-layer PCBs and connectors. Honeywell Bull spent $5 million last year, mainly for terminals, monitors, keyboards and PWBs. Honeywell itself is buying passive components and die castings, among other items. "Name a leading international computer firm, and you can almost be certain to find its IPO in Taiwan," remarks Wu of Unisys. He estimates that the number of such IPOs now totals 30.

The major reason prompting international computer firms to shop in Taiwan is, of course, cost savings. "After taking transportation fees and tariffs into consideration, the purchasing cost here, on a free-on-board basis, is at least 20% lower than the cost in the U.S. Otherwise it's not worthwhile," says HP's Chao.

### Engineering expertise

Another important lure is the island republic's engineering and technical expertise. Local firms are able to design and manufacture a product according to any specifications provided by foreign computer companies instead of having to rely on the latter's manufacturing blueprints entirely. "The competent engineering capability of local manufacturers enables foreign computer firms to shorten the leadtime from design to

production by one-third. This is a crucial advantage in the highly competitive world market," asserts Chao.

The existence of sufficient engineering manpower in Taiwan has also greatly facilitated IPO operations. "In other countries, it's quite unlikely to find so many persons with engineering backgrounds to conduct IPO activities," notes Sheng Ko-kao, IPO manager for Honeywell Bull. At the firm's IPO, five of the eight staff members have engineering backgrounds. In IBM Taiwan's IPO office, 70% of the 60-employee staff are engineers.

Another important consideration is the small-scale operation of most local computer firms which — unlike their South Korean counterparts — have the flexibility to accept small orders. Furthermore, Taiwan boasts a well-established electronics infrastructure.

Consequently, many international firms such as IBM and Unisys have found that, behind Japan, Taiwan is now their second largest source of computer parts in Asia. The Taiwan IPOs tend to focus mainly on the purchase of components while the Japan IPOs generally concentrate on high-end finished products such as printers and disk drives. The South Korean IPOs usually end up buying low-end items such as monitors and terminals.

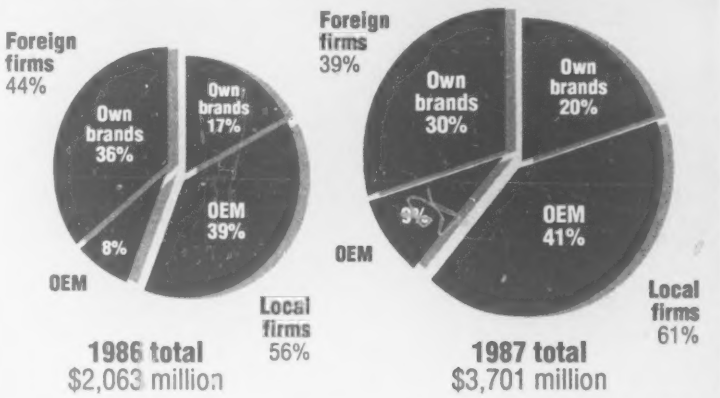
### Serving as a bridge

Essentially, foreign companies use their IPOs as bridges between their factories and Taiwan's local suppliers, finding quality products for the former and helping the latter sell their technology and production capacities. IBM's IPO in Taiwan acts as the primary middleman between a Big Blue factory and a local manufacturer by negotiating prices, settling orders, providing technical support, and assuring the quality and punctual delivery of the purchased goods. "For every one purchasing agent in our IPO, we have 2.52 engineers to provide technical support to our local suppliers," says IBM Taiwan's Michael Huang. "For sophisticated products, we even introduce technology to local manufacturers."

Indeed, for the purpose of technology transfer, IBM has spent $2.2 million in the past three years to invite eight Big Blue engineers to Taiwan and to send three local engineers abroad annually. Furthermore, in 1987 alone, a total of 400 IBM purchasing agents visited Taiwan for business negotiations. "Everyday, you can see at least three to four foreign visitors at our office," says Huang.

### Taiwan's information products export breakdown

Exports of information processing products by local and foreign-owned firms




Source: Taiwan Information Industry Institute

### A consumer mentality

To assure the quality of the goods purchased, IBM Taiwan's IPO helps manufacturers eliminate possible defects through statistical monitoring of the various production processes, rather than resorting to checks upon the delivery of goods. However, quality is still the major obstacle hindering the further development of Taiwan's OEM sales, according to most IPO managers. "We are striving to lower the proportion of defective products to 0.5%, like that of Japan, but there is still some distance to go," notes Edward Lai, NCR Taiwan's IPO manager. Lai adds, "Many local manufacturers are still staying in the realm of consumer goods in their mentality and cannot live up to the high-precision requirement for industrial goods."

**The major reason why U.S. computer firms shop in Taiwan is, of course, cost savings**

Some IPO managers also express concern that many local manufacturers, distracted by potentially lucrative speculation in Taiwan's overheated stock and real estate markets, are reluctant to engage in vigorous investment activities, a phenomenon which threatens the future development of the island republic's information industry.

### Insufficiencies

IPO managers also complain about Taiwan's insufficiency of mechanical and materials engineering capabilities. In addition, IPO managers cite an absence of long-term business planning on the part of local suppliers, who sometimes jeopardize long-term partnerships for short-term windfalls.

IPO managers, in general, however, are harboring a rosy outlook for their purchasing operations in Taiwan. "We expect to continue maintaining high growth in our purchasing for at least the next two years and the value-added of our purchased products will be increasingly higher," says Wu of Unisys Taiwan. To further assure the supply from local manufacturers, NCR Taiwan has even decided to set up a PC assembly operation on the island and invest in some of its local suppliers. □

# Software that links design to test: A step closer?

*Board makers want ATE vendors to cut their test costs; vendors say users must take design initiatives. Board complexity is forcing a resolution*

BY TONY GREENE

Joe Fuller knows it's going to cost a bundle before he even starts. As test engineering manager for Flextronix Inc., a Newark, California-based specialist in assembling and testing surface mount circuit boards, he figures on spending $15,000 to $34,000 to generate the test patterns and create the fixtures for a board test.

And that's just for an in-circuit test taking up to 12 weeks. Forget about functional testing: with engineering time clocking $2,000 a week, the idea never crosses Fuller's mind because the three to six months it takes to generate the relevant test patterns is just too long — and too costly.

High cost of test is a perennial problem for managers like Joe Fuller, particularly as board complexity rises and as surface-mount technology gains acceptance. And it's one that is beginning to reshape the automated test equipment (ATE) industry as newcomers emerge with low-cost gear and the big vendors answer with solutions of their own.

Fuller thinks he has the problem fingered: it's software, or lack of it. What's needed is software that is capable of taking information from computer-aided engineering design files and generating test patterns with it. "The hardware to take CAE data is there," says Fuller, "but the software is not. The in-circuit test equipment manufacturers need to develop a way to download CAE simulation into a tester. One of our biggest problems is trying to make test easier to generate, so we lower the cost of test."

For years, though, board customers and ATE vendors have used the "not my job" ploy to pass the design-through-test ball back and forth. ATE makers maintain that they've bent over backward to help make test simpler; customers say they've had little cooperation. That is having to change, though: as boards grow more complicated, top quality becomes mandatory and mistakes start to cost big money.

Not that the lack of a good interface between design and test is stopping people from buying the machines. According to a report by Mountain View, California-based Market Intelligence Research Co., the total worldwide market for PCB test equipment will be worth $706.9 million this year, and will continue to grow steadily to $1.13 billion by 1992. While there is talk of a slump in the near future for ATE, Stephen Balog, an analyst with investment brokerage Shearson Lehman Hutton Inc. of New York City, believes there will be some demand regardless of the economy, due to a need in the industry to retool.

**Separating design and test means having to recreate the board for manufacturing, says Joe Lassiter, Teradyne's VP for Manufacturing Systems**

The savings possible with a system that integrates design and test are not imaginary. A hypothetical example in a recent report by market research firm Electronic Trend Publications shows how this type of integration can turn into real money quickly on a board containing 150 semiconductor devices, 15 of them ASICs. For a multilayer board of this type, design and test engineering costs would typically average $66,000.

### Immediate savings

If the design and test engineering systems are linked, an immediate savings of $10,000 can be realized by eliminating the duplication of new circuit models. Another $6,000 is saved by not having to reenter circuit topology and develop test vectors. The integration brings the nonrecurring engineering cost down 24% to $50,000. In a company that does 25 new boards like this each year, the annual savings could be $400,000. The savings also spill over into recurring cost by making it easier to test the board. Consequently, notes the report, the total return on investment on a CAE/ATE tie-in could exceed 1,000%.

Those kinds of returns are enough to galvanize even the most traditional test executives. Much as they hate to do it, they all have to test boards that these days are just too expensive to build and repair to risk their being dead on arrival at the customer. Just-in-time manufacturing is also pushing the need to test boards since customers want product that arrives ready to use.

So far, though, those managers in charge of test haven't gotten much satisfaction. Despite all the hype,

workable links between design and test haven't arrived. "Tester and CAE workstations have to be able to talk better. We have to have an integration between the two disciplines [design and test]," insists Kenneth Neff, a market watcher at San Jose-based research firm Prime Data Inc.

The ATE vendors are still working on ways to provide those links. Three major strategies being pursued are:

- Standalone software solutions provided by the vendor that can be ported into the vendors' hardware solutions. Teradyne Inc. of Boston, one of the leaders in the board test market, is following this strategy with the creation of the Design and Test automation group, and with its purchase of Aida Corp. and Case Technologies Inc. Teradyne entered the CAE market with Lasar, software it has sold in conjunction with its test equipment for years. Teradyne sold about $120 million in board test equipment last year; and spent over $15 million on R&D, about half of that on software development.
- Test generation software that is part of the test system package. GenRad Inc. of Concord, Mass., has taken this approach with its Genesis software that includes system Hilo, a simulation toolkit that goes from design verification to automatic test generation. This software is one of the major features of GenRad's new GR2750 board tester. GenRad has also entered into strategic agreements with companies such as Diagonal Systems Ltd. of Zurich, Switzerland, to create a system that links design information from all major workstation companies to GenRad board test systems. GenRad spent $23 million on R&D last year, as much as 75% of it on software development.
- Designing open test systems that will be able to interface with whatever tools the customer is using. "The reality is that we have to live in a multitool environment," says Alex Beavers, vice president for field marketing and federal systems for Schlumberger Technologies of New York City. Hewlett-Packard Co. of Palo Alto, Calif., also follows this philosophy and has concentrated on test fixturing. "We believe, in terms of simulation, that we need to be able to integrate it into our own system. We have a product that goes out to the printed circuit layout system," says HP's general manager of manufacturing, John Scruggs.

**Richard J. Faubert, VP for product development for GenRad: "Test and design should be happening in parallel"**

### It's up to the customer

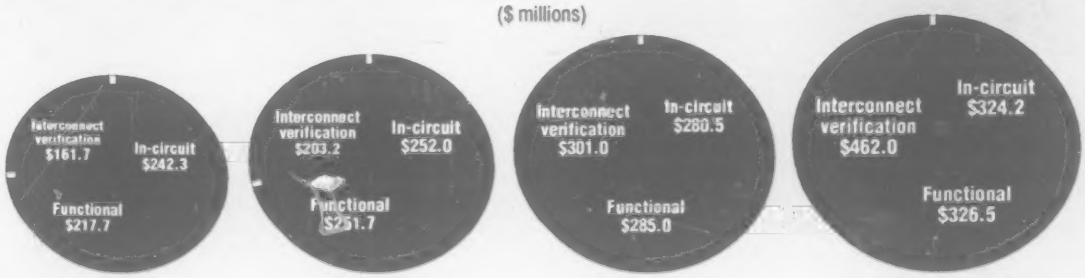
Implementation is up to the customer, though. "If people will design for test, the integration [of design and test] will happen naturally," says Teradyne's manufacturing systems division vice president Joseph B. Lassiter. "If you design things so that they can be tested, you can really integrate effectively. But as you separate them, you create a situation where you have to recreate the product to manufacture it," he says.

"A change in management philosophy toward test is necessary," contends Richard J. Faubert, vice president for product devlopment for GenRad. "Test and design should be happening in parallel." Market analyst Carolyn Rogers of Hambrecht & Quist Inc. agrees: "You don't just have to change the software, the philosophy of test has to change."

Despite what they say, test equipment makers are not alone in their quest to change the philosophy of test. Robert Russell, principal test engineer for Honeywell-Bull Inc.'s Brighton, Mass., facility says, "It doesn't make sense to wildly make a board you can't test. A test engineer will always look at a board at some stage of development and give the designer input. You need design and test working in parallel." Russell boasts that Honeywell-Bull's design

## Worldwide PCB ATE market

($ millions)




**Total 1986** $621.7 million

**Total 1988** $706.9 million

**Total 1990** $866.5 million

**Total 1992** $1,112.7 million

Source: Market Intelligence Research Co.

and test engineers have been working together for 10 years.

The forces driving for a new philosophy in test are also encouraging other changes in the test industry. One of these is the birth of a new breed of tester — a combinational tester that handles both in-circuit and functional test. Teradyne, Hewlett-Packard and GenRad have all put new entries into the field in this area. GenRad's Faubert says, "The technology on the boards is forcing people toward a mix of functional and in-circuit test." Adds HP's Scruggs, "Our focus is very strongly in the area of combinational test. We want to meet the needs of customers using SMT and ASICs."

**Built-in test**

Another sea change is the push for built-in test techniques, where testability is designed into the board. "Without some kind of built-in test, people are not going to test their boards," says Prime's Neff. "In the next five years or so, it is going to become mandatory." Built-in test, such as boundary scan — a method that allows examination of just the "boundary," or inputs and outputs from a chip on a board to be tested — also relieves some of the test-generation nightmares caused by today's boards.

In addition, many small test equipment companies are coming on the scene to offer low-cost test solutions. One of these, Support Technologies Inc., of Portland, Ore., functionally tests boards by accessing the boards' microprocessors and running the boards at speed. Marconi Instruments Inc.'s Avionics Division uses Support Technologies Inc.'s 3000 Series machine, whose price tag of up to $80,000 looks paltry alongside the $1 million label that conventional large functional machines carry. Explains Frank Riccardi, Marconi's test engineering section head, "It didn't make sense for us to buy a big functional tester."

**Built-in test relieves some of the test-generation nightmares caused by today's boards**

Summation Inc. is another newcomer offering a low-cost solution to the large problem of functional test. With equipment prices checking in at $40,000 to $80,000, the little Kirkland, Wash., firm offers mixed signal functional test coverage. Both Summation and Support Technologies have concentrated heavily on software that makes test generation easier and faster, and both have implemented this software through innovative techniques for accessing boards.

While these companies — Support Technologies with sales of $6 million and Summation at $10 million — are dwarfed by the test giants, the business they are taking away could still become a thorn in the side of the Teradynes and GenRads. Notes one observer: "For each $25,000 machine they sell, they may take the place of a $500,000 GenRad machine." □

## New names for old testers?

The jury is still out and the debate rages on over which is better — in-circuit or functional test. Since the earliest days of the board test business, the benefits, costs and problems created and solved by these machines have spawned fierce loyalties and bitter feuds. The question is: Who's winning the battle?

The answer is: both. "In-circuit is living and flourishing and will continue to flourish for the bulk of general commercial products," says Joseph Lassiter, vice president for manufacturing systems at Boston-based Teradyne Inc., "and functional test will be here forever for military boards and high-end commercial products." The figures back this up, with Teradyne's $120 million in board test equipment being split right down the middle between functional and in-circuit. Asked to pick one as the best, Lassiter says, "If you have time, functional is a better test."

At Concord, Mass., ATE vendor GenRad Inc., Richard J. Faubert, vice president for product development says, "In-circuit and functional is a bad partitioning." GenRad has begun defining its board testers as *process* or *performance* testers. This distinction is more a difference in price than method of test. *Process* testers cost less — at under $500,000 — than *performance* testers, which price out at over $500,000. "The technology on the boards is forcing people toward a mix of functional and in-circuit test," explains Faubert.

**Combinational testers are not creating a new market**

Kenneth Neff, an analyst for Prime Data Inc. of San Jose, agrees that the definitions are changing, and says what the consumer is looking for is a low-cost machine that does both in-circuit and functional test. This has given birth to a new contender — the combinational tester. The definition is not firm, and Neff says, "Combinational testers have been around for about four years, but this year we are going to start tracking them." Neff says that the market share they take will probably come from the share of pure functional testers. Combinational testers are not creating a new market, but they are competing with their parents for the same markets.

These testers are not only going to have to do more, they are going to have to do it for less. William B. Bean, president of low-end ATE vendor Marconi Instruments Inc., says, "In the U.S., the real action is going to be in low-cost test solutions. There is going to be a dramatic switch from mid-price to low-price systems." In answer to this need, Marconi has come out with a combinational tester that comes in between $45,000 and $65,000. □

# Wanted: U.S.-made printed wiring boards

*In the U.S., the Japanese want local PWB sources. If U.S. firms don't shape up, Japanese PWB suppliers could invade the market*

Many Japanese electronics firms engaged in manufacturing operations in the United States have basically been doing assembly work, or so-called "knockdown" manufacturing. However, the soaring value of the Japanese yen and mounting political pressure to resolve, or at least ease, the current trade imbalance are pressuring these companies to buy more local parts from U.S. sources. Many of the U.S. operations of Japanese companies are finding good components that are made in the United States and are cheaper than those from Japan. However, there are still many critical parts which cannot satisfy their requirements. Printed wiring boards (PWBs) are one such item. The United States is home to many excellent PWB manufacturers, but these are normally captive shops.

In the past few months, I've visited a dozen Japanese knockdown manufacturing facilities scattered throughout the United States. Their complaints are almost identical:

- Many independent PWB shops in the United States say they have the best quality around. Many boast of the number of board layers they can laminate. But their clean rooms are not always clean. Operators are often not wearing hats; their long hair hangs down. And yet these shops brag about their terrific quality control.
- The facilities that do quality work are already tied up with U.S. customers. Foreign-owned operations have no chance to be served.
- U.S. PWB shops are rather conservative in spite of their leading technology. When approached with designs involving 5-mil lines with 5-mil spaces and small via holes of 12- to 14-mils in diameter, many either shy away or quote very high prices and long delivery dates.
- Japanese electronics manufacturers use more boards with surface mount technology than their U.S. counterparts. Board quality consistency is essential for mass assembly of SMT boards. But, because of the limited quantities available from any one shop in the U.S., the Japanese must depend on several suppliers to satisfy their volume requirements. This makes it difficult to achieve satisfactory consistency of board quality. Common problems include board warp and twist, and misregistration of the solder mask, to name a few.

BY HAYAO NAKAHARA

**Hayao Nakahara is managing director of Far Eastern operations for the PCK Technology Division of Kollmorgen Corp.**

And the list goes on. The complaints may sound overly critical, but they are the same heard from American buyers roaming around the Far East in search of PWBs there.

The PWB industry today is a capital-intensive business, just as the semiconductor industry is. Many independent PWB shops in the United States are undercapitalized. The average independent U.S. shop is much smaller than its Japanese counterpart. There are over 1,000 PWB manufacturers in the United States and they produce about $5 billion worth of PWBs annually. By contrast, in Japan, there are 300 or so manufacturers producing almost the same amount. Because of such circumstances, Japanese systems houses manufacturing in the United States are asking their board suppliers in Japan to come here and erect local PWB manufacturing plants in order to supply quality boards in volume and at competitive prices.

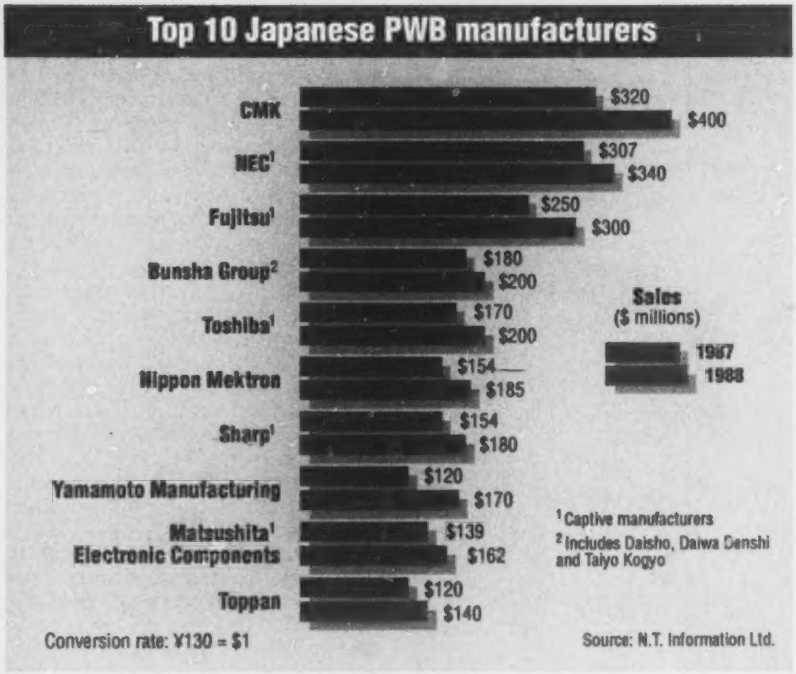
Another reason for the encouragement is the Japanese systems houses' unfamiliarity in dealing with U.S. board suppliers and American business practices. For example, the price for prototype boards in Japan is not much more than the price for mass production units, because the Japanese vendors hope that with an initial sale, they can then win mass production orders.

The Japanese are also used to working with shorter leadtimes. Even when business is booming, the longest leadtime in Japan is between four and five weeks, whereas in the U.S., it is normally 12 to 15 weeks under similar circumstances.

Furthermore, in the United States, it is customary for board manufacturers to be able to charge 30% to 50% more if their delivery times are shorter than the prevailing industry leadtimes. However, in Japan, this is not the case. In fact, if a PWB manufacturer in Japan insists on charging extra, the company leaves itself open to a harsh penalty fee if the delivery date is delayed. Yet, in the United States, PWB manufacturers just shrug their shoulders when their deliveries are tardy.

Not surprisingly, in the past few years, a number of Japanese independent PWB manufacturers have been investigating the possibility of building manufacturing plants in the United States under strong pressure from their customers operating here. Topri was the first Japanese company to build a U.S. PWB facility in the late 1970s, but it went belly up for various reasons. The lack of marketing skill in this marketplace was probably the No. 1 reason.

Hitachi Chemical Company Ltd. built a board manufacturing plant near Atlanta in 1985, but its customers are 100% U.S. companies. CMK purchased a property near the U.S.-Mexico border as a future plant site. NOK Corp. has been building a PWB plant in Silicon Valley, which is sup-




posed to be operational in January 1989. Its PWB division is better known as Nippon Mektron. Former ally of the Rogers Corp. of Rogers, Conn., it produces about $170 million dollars worth of flexible PWBs, roughly 35% of Japan's total annual production of such boards.

Some Japanese PWB makers are also looking to buy existing facilities. Toppan Printing Co. recently entered into an agreement to purchase Industrial Circuits Inc. of San Diego.

But all these firms are big companies with financial clout. The PWB companies that are under fire to come to the U.S. to serve their Japanese customers operating here are medium- to large-sized independents. It is difficult for them to do so.

There are several reasons why. First, they are fiercely competing to hang onto their existing customers in Japan whose requirements for pricing, delivery and quality get tougher every year. And to satisfy the ever-increasing demands, they must keep investing — not necessarily in productive machinery, but also nonproductive equipment such as automated optical inspection systems, fancier electrical testers, waste treatment facilities, etc. It is called the "bicycle syndrome." If one stops pedaling, he falls. And the profits are very thin, not like in the good old days of the 1970s and early 1980s. The investment in Japan is so heavy for the medium- to large-sized independents that they haven't any capital left to set up a plant in the United States.

Second, unlike captive shops which normally belong to large conglomerates, independents cannot attract graduates from the famous Japanese universities that produce engineers possessing a fair command of the English language. Those graduates with foreign language capabilities seek jobs elsewhere. So, independents have no one in their organization qualified to spearhead a project in the United States.

**Several independent Japanese PWB makers are forming partnerships in the U.S.**

Third, even if they could go ahead with building a plant, they do not have the marketing expertise necessary to sell their products in the United States. And they just cannot afford to depend solely upon their Japanese customers. They must sell in the worldwide market to justify the risky investment, ranging from a minimum of $20 million to upward of $35 million, required to establish a U.S. plant.

So, what's happening is that several Japanese independent PWB manufacturers have established liaison offices in the United States, mainly on the West Coast, and have been trying to, through quoting activities, garner a feeling for prices and business practices in America. At the same time, they have been looking for U.S. partners that can deliver boards passing the specs demanded by those Japanese customers seeking quality parts. Various Japanese customer criteria — for solder mask misregistration; types of finish; thickness of gold plating, if desired; warp and twist; tolerance of error from datum to a certain key pad for surface mounting; etc. — are communicated between the Japanese board vendor and its prospective U.S. ally.

This approach is welcomed by both sides of the Pacific because the Japanese can serve their customers in a satisfactory manner and the U.S. "helper" can learn something from its Japanese partners, particularly in regard to automation.

There will be several such alliances springing up in the next few years. There may even be a few independents building their own shops here despite of the difficulties mentioned previously.

And it is only a matter of time before some so-called "captives" such as Fujitsu Ltd. and NEC Corp. begin building PWB manufacturing plants in the United States. Although considered captive, NEC, for example, sells more than 30% of its production — roughly 200,000 square feet of double-sided and four-layer boards — outside the company. In reality, many "captives" in Japan are not literally captive businesses. The board operations of Matsushita Electronic Components Company Ltd., Fujitsu, NEC, Toshiba Corp., and Oki Electric Industry Company Ltd., are all thought to be captives. However, they are all actively engaged in selling PWBs to outsiders, even to their parents' competitors. In fact, of Japan's top 20 largest PWB manufacturers, only Hitachi Ltd. does not sell its boards outside the company. □

to your RFP, i.e., estimated costs, leadtimes, quality levels, first delivery and other terms and conditions.

Review the responses to your RFP. The information supplied can provide the key ingredients for negotiating with and selecting the right contract manufacturer for your company.

Now you are ready to narrow your short list of candidates and select the best qualified contractor(s) — at least on paper. At this point, your team of purchasing agents, supplier quality and process engineers should be prepared to conduct initial site visits and engage in preliminary negotiations with the most promising potential contractors. You should now be set to review the results of the selection effort with your management team and obtain approval on your recommendations.

Final agreements on terms and conditions for production buys should be contingent on the contractor successfully passing your supplier qualification program. The supplier qualification and certification process described next is the best way to ensure that the contractor is indeed a capable producer and will be able to grow with you.

**5. Qualify your contractor**

Don't stop now. Unfortunately, the tendency after spending the time and effort to select a contractor is to congratulate yourself on a job well done and move on to other pressing business. For electronics manufacturers, selection should signal the beginning of qualifying and ultimately certifying a supplier.

Companies use a variety of methods and tests for declaring that a supplier (or contract manufacturer) is sufficiently worthy of being added to their "approved vendor list." Suppliers usually remain on such a list for a continuing period of time — unless, of course, something goes wrong. All too often, only the quality of the parts gets the buyer's attention. Little notice is given to the firm's business strengths and weaknesses. So, if problems crop up, they are usually surprises. It's too late when a company's ability to meet production schedules, cost targets or quality levels, has been adversely affected by lack of capital, capacity or process controls at a supplier.

As an alternative, we suggest an approach to the supplier qualification and certification process that separates evaluation of the part or assembly from that of the vendor's business. Treat these as separate issues and evaluate them independently.

To implement this process, you must first develop detailed criteria to evaluate both the ability to manufacture your components and the business capabilities of your contractor. Incorporate the part acceptance criteria and reliability testing into your engineering evaluation process. To review the business of your contractor, document and assign values to key criteria in a questionnaire format. Be sure your criteria adequately cover:

- financial condition and track record;
- competitive position, key customers and market share trends;
- engineering capabilities;
- technology assessment;
- manufacturing capacity and response time;
- and management.

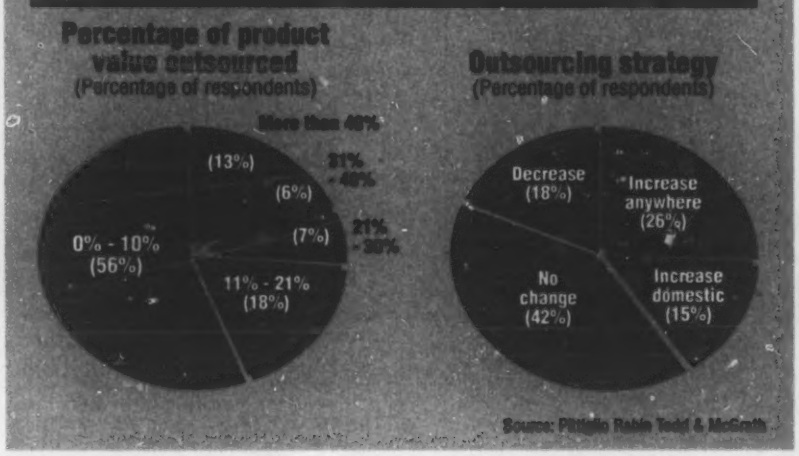
By assigning values to each question, the results of the survey can be expressed quantitatively. Qualification ratings, such as A, B, C and so on, can be established for scores in each category. To achieve an overall qualification rating, a supplier must receive at least that rating in each survey category. This is a critical step to successfully implementing this approach. The right individuals from your company must be involved, including:

- **senior management,** to meet with and assess the strengths and weaknesses of the supplier management team;
- **process, component and supplier quality engineers,** to evaluate and complete the manufacturing capacity, technology, process controls and engineering capabilities sections of the questionnaire;
- **marketing and finance divisions,** to assess the market position and financial position of your contractor;
- **and purchasing management/senior buyers,** to orchestrate the survey

## Contract manufacturing is on the rise

Electronics manufacturers are looking to contractors to supply substantially more of their product needs, according to the American Electronics Association's 1988 Productivity Survey. Currently, the industry relies on contract manufacturers for only 19% of its product value, with 56% of the industry companies doing all production in house. The increase in contract manufacturing is also evidenced by the growth of major firms such as Flextronics Inc., SCI Systems Inc. and Solectron.

About 41% of the survey respondents indicated that they planned to place more work with contractors, while 18% will bring a portion of their work in house. The survey also detected a definite bias to using domestic rather than foreign contractors. □



# ISDN is changing the face of telecommunications - slowly

*Although widespread ISDN services won't be a global reality until sometime early in the 21st century, ISDN's here to stay*

The first Integrated Services Digital Network (ISDN) commercial services are now available. By the year 2000, residential users and all size businesses will have access to ISDN services.

By the year 2010, I expect to see broad residential availability to a set of international standards, whose implementation provides an integrated point of access to a range of technologies and transmission paths for delivering simultaneous voice and data transmission.

But even though ISDN promises to dramatically alter the nature and provision of telecommunications services, ISDN's acceptance has been slow. This has been caused, in part, by the inability of carriers to explain adequately ISDN's vast potential.

Although digitalization (installation of digital switching and transmission systems) of the network was planned as part of routine network modernization, it requires carriers to make extensive capital investments. Digitalization provides the foundation for ISDN, but equipping the network for ISDN requires even greater capital expenditures. The investment is worthwhile, but carriers and their suppliers must better explain to subscribers the advantages some of the more sophisticated ISDN services can provide, and then price them reasonably to attract the customers they need to recoup that investment.

BY H. PARIS BURSTYN

**Burstyn is director of telecommunications for Business Research Group, a newly formed market research arm of Cahners Publishing Co.**

### Three-tiered industry

The ISDN market comprises three tiers: subscribers, carriers and equipment suppliers. Sitting in the middle, the carriers play a crucial role. ISDN casts them as competitive, versus monopolistic, entities. Service providers must position any ISDN service so it can effectively replace customer premises equipment-based communications systems as well as solutions, based on combinations of separate network services. Carriers must carefully listen to subscribers and communicate their needs to their equipment suppliers, in order to deliver the software and hardware carriers need to service subscribers.

Digitalization allows carriers to provide subscribers with such ISDN-related service delivery architectures and systems as Signaling System 7 and database-oriented Intelligent Network. ISDN can integrate information from equal access software (or other central office software generics) and out-of-band signaling. This feature delivers the calling party's phone number and other data, so subscribers can combine that information with a database to provide customer profiles to the people who answer the phone. This service can improve the efficiency of telemarketing and customer service organizations. A similar, and in some ways competitive, feature is available on most digital PBXs, but ISDN can deliver signaling information from a distant central office so outside callers can also be recognized.

In other applications, ISDN can provide subscribers with the tools to reconfigure their public network services instantaneously to meet changing traffic patterns. Eventually, ISDN will automatically identify to the network the type of terminal being used to place a call, thus automatically routing workstations to data circuits; telephones to voice circuits; and video cameras to wideband facilities.

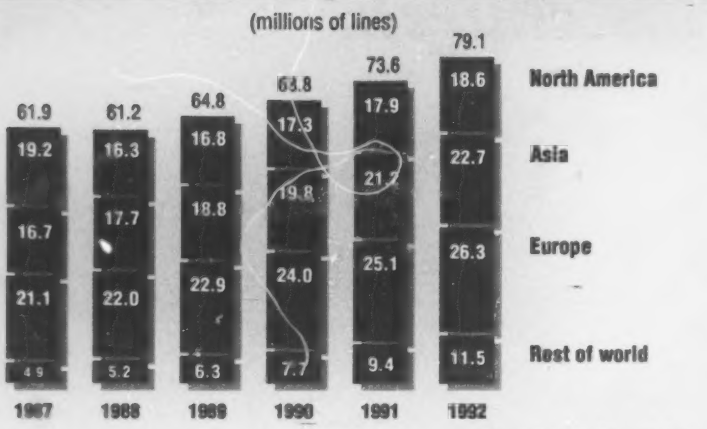
These new ISDN services differ from existing independent products and services. Although available systems could be pieced together to deliver something similar, doing so would take many man-hours coordinating a variety of vendors. Instead, ISDN offers the advantage of a single contact point for integrated services.

Effectively providing ISDN-based services rests on tying together extensive processing, software and database-oriented resources. The opportunities for vendors in each of these markets is extensive. To the subscriber, it makes no difference whether the applications processor it is using resides on its premises, in the network, or at some third-party facility. All that matters is that access to the applications is easy for the particular user and cost effective for the business.

Many opportunities exist for a range of joint marketing and joint venture arrangements among carriers, telecommunications equipment vendors, computer manufacturers and value-added network providers. Some carriers and their large customers are already working together to develop and justify ISDN applications. For example, AT&T, in conjunction with a number of large users and local exchange carriers, has inaugurated a program called TriVista. It brings a three-pronged approach to developing and evaluating potential ISDN applications.

Many companies have taken a conservative, wait-and-see approach to installing ISDN. Some large users, such as American Express and Tenneco, have been enticed to try ISDN. They are working with the carriers to develop ISDN-based applications and techniques for meeting business communications requirements. These uses will then trickle down to smaller companies and spread to

## Worldwide shipments of access lines




Source: Business Research Group

comparably sized companies.

Most importantly, subscriber needs will steer ISDN service evolution, and drive telecommunications equipment and service providers to develop network-based solutions to business problems. Secondarily, competition, regulation and technology determine the environment, guidelines and means by which telecommunications carriers and equipment suppliers deliver new ISDN products.

### Changing global market

The list of companies — telecommunications carriers and equipment suppliers — responding to consumer demands includes some of the largest multinational corporations. But for most firms, ISDN market dynamics are different from those in which these firms are used to operating.

In European countries, domestic suppliers, such as Siemens in West Germany and Alcatel in France, have been virtually guaranteed the largest share of their post office and telecom equipment markets. But change in Europe is brewing; the European Community agreed to create a regional telecommunications market by 1992, to create more broad-based competition. Domestic market security is no longer assured.

In the United States, AT&T has only faced serious competition in the central office switch market, from Northern Telecom, for the last 10 years. But it recently enhanced its position in this market by agreeing to acquire GTE Corp.'s switching business, thus guaranteeing itself a large share of future purchases by GTE's operating telephone companies.

Japan's domestic suppliers, like Europe's, have enjoyed virtually exclusive access to their home market. But there is a possibility that some outside suppliers will land major switching contracts in that country.

With digitalization of the network progressing rapidly, I believe the way carriers price the integrated services provided over that digital network will be critical in this competitive, price-sensitive market. For example,

**Despite the promise to alter services, ISDN's acceptance has been slow**

one U.S. company using ISDN at no charge said it was so committed to ISDN it would stay with it despite what its local exchange carrier (LEC) eventually decided to charge. If the LEC's prices were too high, the subscriber would simply bypass it. Monopolistic government entities must also be aware of price sensitivity; traffic levels in Germany have been falling in recent years due, at least in part, to exceptionally high tariffs.

### Strategic role

In view of these developments, I believe ISDN will play a strategic role for carriers, equipment suppliers and subscribers.

- Carriers must use ISDN to win subscribers away from customer premises equipment-based (CPE-based) solutions. This will require designing useful services to attract subscribers and carefully gauging how much subscribers will pay for these services.
- Network equipment suppliers must continually enhance their equipment's ISDN capabilities to maintain and increase their market shares. They should, therefore, recognize which services carriers want to provide first and then prioritize their development efforts to meet those needs.
- Subscribers must evaluate ISDN as a potentially cost effective solution to a range of communications problems, and a source of more efficient communications resources unavailable until now. With a clearly defined market strategy, some subscribers could gain a competitive edge in their markets by employing ISDN-based services.

What's at stake for the suppliers are markets for both equipment and services that defy accurate description. Worldwide, carriers added nearly 62 million new access lines during 1987. Because digital switch costs-per-line vary widely, depending on vendor, the country, and the amount of government support provided, it is difficult to estimate an average price per line. Given that caveat, Business Research Group estimates the market for new switches in Asia, Europe and North America, where most of the world's ISDN-capable switch sales will take place, approached $49 billion in 1987. During 1988, the market remained virtually stable at about 61 million lines shipped and at $49.5 billion.

This situation of little growth originates from the fact that the U.S. market experienced a spurt during 1987 when over 19 million new lines of switching were installed. It settled back to slightly more than 16 million lines in 1988. That slowdown was offset by overall growth in the rest of the market. Increasing prices and inflation accounted for the growth in dollar volume.

BRG believes a very small portion of new lines shipped in 1987 were provisioned for ISDN. The first sig-

nificant shipments of such lines took place in 1988, and by the end of the year we estimate that more than 12,000 ISDN lines will be in service in the United States. This number should increase extremely rapidly through 1991, when more than 10 million new lines will be shipped in North America. By then, the approximately 11 million total ISDN access lines installed will account for less than 5% of the total number of access lines in the region.

Europe should experience a similar shipment rate with about a year's lag time. That is, Europe should see about 55% of its new line shipments provisioned for ISDN in 1992.

Although the central office switch market is the most glamorous of the telecommunications equipment markets because it garners so much attention in the press, relative to the total equipment market, it accounts for a small portion of the world's telecommunications equipment market. Digital cross connect systems, subscriber loop systems, transmission gear, termination equipment and many other components add tremendous value to the market's potential. Equipment suppliers competed for nearly $99 billion of spending by the world's telecommunications carriers in 1987 and over $101 billion in 1988. And the market continues to grow. The signaling system component of ISDN network provides an excellent example of one source of market growth. Carriers that did not use interoffice signaling before must now install it, and those that used interoffice signaling in their toll networks must now extend it to local exchanges.

From the carrier's standpoint, the added revenue created by ISDN can play a critical role in helping pay for increasingly expensive network upgrades. The services go a long way toward high margin revenue streams. ISDN-derived revenue, which barely exists today, shows a potentially large new source of revenue and profit for carriers. Through 1990, as more ISDN installations come on-line and an inventory of applications is developed, worldwide ISDN service revenue could amount to $25 billion.

ISDN technology alone won't generate these new revenue streams. Subscribers will also require substantial education about ISDN and its applications. But most importantly to generate this additional revenue, telephone operating companies and their suppliers, must guarantee the public network's ability to respond to subscriber demands for competitive pricing, service control, flexibility and reliability. Digitalization of the public network virtually guarantees that carriers can deliver customer-controlled, flexible and reliable ISDN-based services in areas where the regulatory environment allows such services. But it remains up to the carriers to employ this technology to deliver services that will successfully use network capabilities; generate adequate traffic and revenue to recover investments; and produce profit while meeting the needs of its customers. □

A special, though somewhat taxing, message to readers of ELECTRONIC BUSINESS:

Give your friends a present they're already entitled to

Ask DAN
About your Taxes

*The means to the right tax deductions*

**TAX FORMS Ask DAN will complete:**
Form 1040: U.S. Individual Income Tax Return
Schedule A: Itemized Deductions
Schedule B: Interest and Dividends
Schedule C: Sole Proprietorships
Schedule D: Capital Gains and Losses
Schedule E: Rent, Royalty, Partnership
Schedule F: Farm Income and Expense
Schedule R: Credit for Elderly and Disabled
Schedule SE: Self-Employment Tax
Form 2106: Employee Business Expenses
Form 2119: Sale of Principal Residence
Form 2210: Underpayment of Estimated Tax
Form 2441: Child Care Credit
Form 3903: Moving Expense
Form 4562: Depreciation Expense
Form 4684: Casualty or Theft
Form 4797: Supplemental Gains and Losses
Form 6251: Alternative Minimum Tax
Form 6252: Installment Sale Income
Form 8582: Passive Activity Loss Limits
Form 8598: Home Mortgage Interest
Form 8606: Nondeductible IRA Contribution
Foom 8615: Child With Investment Income
Form 1040-ES: Estimated Tax Worksheet
Tax Scenarios Worksheet (for 'What if')
Depreciation Worksheet
Rentals Worksheet
Your "Ask DAN" Checklist
Your "Ask DAN" Auditor
Worksheets for Form 8582
Integration of state taxes

SEND TO:
Legal Knowledge Systems Marketing
P.O. Box 695
Drexel Hill, PA 19026
Tel: (215) 789-3679 and (215) 446-5470
To order, call toll free: 1-800-338-1866

A fair tax return. Give them "Ask DAN About Your Taxes," the first personal tax preparation program that provides expert help, looks for deductions you may have overlooked.

All they'll need to profit from your present is an IBM PC, XT, AT, PS/2 or true compatible computer, running DOS version 2.0 or later, with 512K bytes of RAM, and two disk drives (better if they have a hard disk).

Business Week magazine (March 21, 1988, pp.164–165) rated Ask DAN "the top choice" in spite of "minor bugs." The New York Times (March 8, 1988) wrote that Ask DAN "handles tax preparation in the same way the other programs do, but it adds a new dimension: knowledge."

Knowledge is what makes Ask DAN unique. Knowledge of the new tax law allows Ask DAN to customize your return to your specific needs. To Ask DAN, you're unique.

Add yourself to your gifts list.

**Order Ask DAN's tax-planning version**

☐ Send me the tax-planning pre-release by Dec. 5. Enclosed is my check for $89.95, plus $3.50 for shipping. (Postmark by Nov. 21. Pennsylvania residents: add $5.40 state tax.) This includes a free update early next year for tax preparation, after the IRS releases all the new tax forms for 1988.

I want the program in: ☐ 5¼" (four floppy disks) ☐ 3½" (two diskettes)

☐ I don't want the tax-planning version, but wish to order Ask DAN early for tax preparation. Enclosed is my check for $69.95, plus $3.50 for shipping. (Postmark by Jan. 15, 1989. Pennsylvania residents: add $4.20 state tax.)

SHIPPING INSTRUCTIONS:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

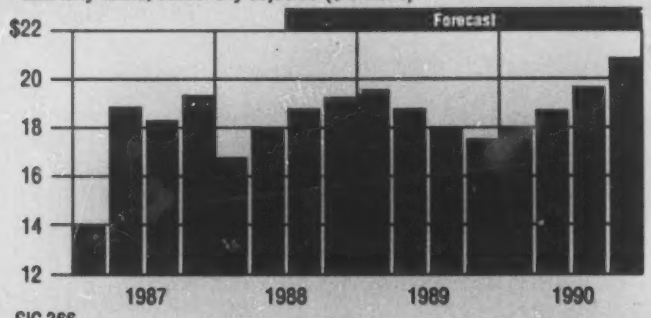
TELEPHONE: (daytime) _____ (other times) _____

Special Instructions _____

192

## Communication equipment — New orders

Quarterly totals, seasonally adjusted ($ billions)

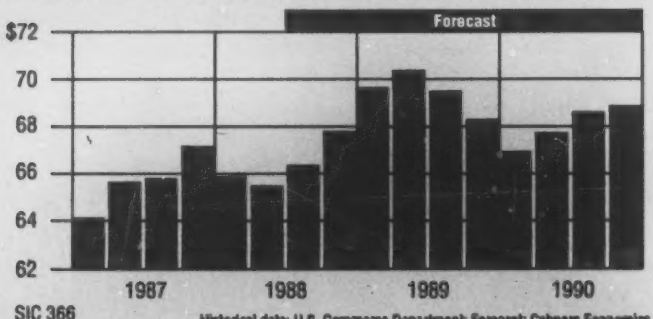



SIC 366

Historical data: U.S. Commerce Department; Forecast: Cahners Economics

## Communication equipment — Unfilled orders

End-of-quarter totals, seasonally adjusted ($ billions)

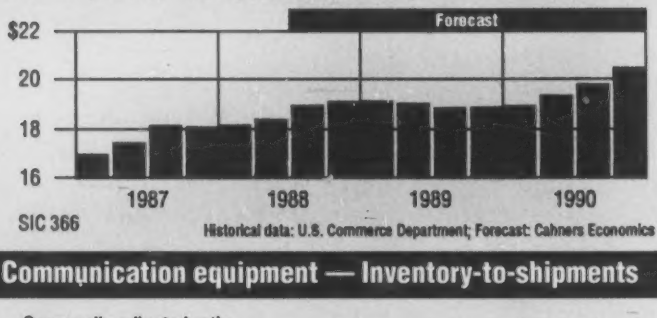



SIC 366

Historical data: U.S. Commerce Department; Forecast: Cahners Economics

## Communication equipment — Shipments

Quarterly totals, seasonally adjusted ($ billions)

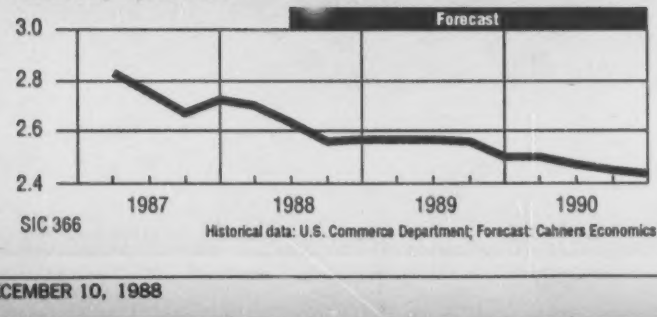



SIC 366

Historical data: U.S. Commerce Department; Forecast: Cahners Economics

## Communication equipment — Inventory-to-shipments

Seasonally adjusted ratio




SIC 366

Historical data: U.S. Commerce Department; Forecast: Cahners Economics

# Communication equipment gains

The U.S. Census Bureau recently revised historical shipments, new orders, unfilled orders and inventory data back to 1982. The changes reduced the values of orders, shipments and backlogs for communication equipment for 1987 by about 5%, while inventory reflected little adjustment.

From July to August of this year, new orders for communication equipment took a nose dive, coming in at $5.8 billion, a decrease of 6.7%. Weak orders for radar, sonar, navigation equipment and other defense-related communication equipment were responsible for the decline, as new orders for nondefense communication equipment gathered strength in August.

Shipments trailed off 2.9% from month to month. Surprisingly, the big loser in this case was the commercial sector, while shipments of defense communication equipment remained stable. The decline brought the August total to $6.1 billion, just 1.7% ahead of the year-ago month. Although shipments will fluctuate on a monthly basis, don't expect annual growth to get above 6% this year. The commercial sector is expected to do slightly better than the overall. Factory shipments of nondefense communication equipment are expected to end 1988 about 7% to 8% higher than last year.

**Foreign shipments, domestic investment up**

Increased foreign sales are one reason for the renewed vigor. Through the first half of this year, U.S. exports of communication equipment (largely commercial) totaled $3.1 billion, a surge of about 31% above last year.

At the same time, growth in imports of communication equipment has slowed. From 42% annual growth in 1984, increases dwindled to less than 1% in 1987. Through the first six months of 1988, imports advanced about 4%. However, in dollar size, imports still dominate the market. Back in 1981, imports were about 2.2 times the size of exports. By 1987, the value of imports skyrocketed to 4.2 times the export value.

In 1988's second quarter, businesses purchased $43.7 billion worth of communication equipment. This represents increases of 10% from the year-ago quarter and 2.5% from the prior quarter.

But increases in equipment investment are slowing and the gain from exports won't be as great next year. All this will tell in the growth rates for orders and factory shipments of communication equipment.

MADELINE FRANCHI

# Computer market is in good shape

The U.S. Census Bureau once again completed its annual revisions to shipments, orders, backlogs and inventory data. Changes to the 1987 data were significant. Orders and shipments for computers and office machinery were raised between 6% and 7%, while unfilled orders were cut from $18.7 billion to $14 billion at year-end.

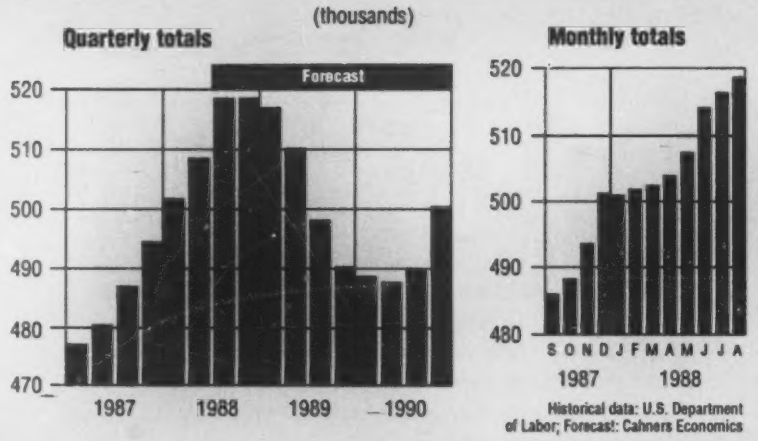
August was a good month for computer and office equipment makers. New orders swelled 5.6% from July up to almost $6.2 billion. Shipments advanced strongly, too, growing 2.1% from July to stand at $5.9 billion, or 15% above August of a year ago.

This strong showing keeps our forecast of 12% annual shipments growth in 1988 right on track. But remember, these series are measured in dollars, not units. So, some of this growth may be due to the sudden burst in computer prices as manufacturers finally passed on their increased costs for chips. Nevertheless, the current increases are good news and help mitigate fears that purchases of PCs were slowing down.

Another indicator of a robust market, employment, also increased. Total employment in the computer and office equipment industry edged up half a percent from July to August, or about 29,000 persons more than last August. Employment of production workers climbed almost 1% in the middle of the summer.

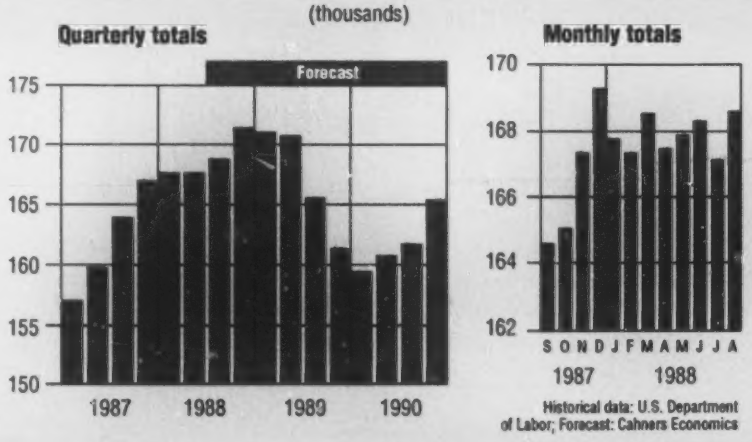
MADELINE FRANCHI

## Computers and office machinery — Total employment




Historical data: U.S. Department of Labor; Forecast: Cahners Economics

## Computers and office machinery — Production workers




Historical data: U.S. Department of Labor; Forecast: Cahners Economics

## Computer market database

| | Latest month | Previous month | Change | Year ago | Change | Next year | Change |
|---|---|---|---|---|---|---|---|
| **Industrial production** (SA,1977=100, Aug.) | 317.6 | 315.9 | +0.54% | 282.1 | +12.58% | 318.3 | +0.22% |
| **Shipments** (SA, $ millions, Aug.) | $5,899 | $5,779 | +2.08% | $5,123 | +15.15% | $5,728 | -2.90% |
| **New orders** (SA, $ millions, Aug.) | $6,180 | $5,853 | +5.59% | $5,066 | +21.99% | $5,577 | -9.76% |
| **Unfilled orders** (SA, $ millions, Aug.) | $14,175 | $13,894 | +2.02% | $14,221 | -0.32% | $12,908 | -8.94% |
| **Inventory-to-shipment ratio** (SA, Aug.) | 1.96 | 1.99 | — | 2.03 | — | 1.95 | — |
| **All employees** (thousands, Aug.) | 518.6 | 516.1 | +0.48% | 489.6 | +5.92% | 498.1 | -3.95% |
| **Production workers** (thousands, Aug.) | 168.6 | 167.1 | +0.90% | 165.7 | +1.75% | 165.7 | -1.71% |
| **Exports** ($ millions, Aug.) | $1,836 | $1,787 | -7.64% | $1,482 | +25.7% | $1,820 | +1.87% |
| **Imports** ($ millions, Aug.) | $1,959 | $1,828 | -10.21% | $1,589 | +14.20% | $2,071 | +13.33% |

SA = seasonally adjusted, all other data is not seasonally adjusted

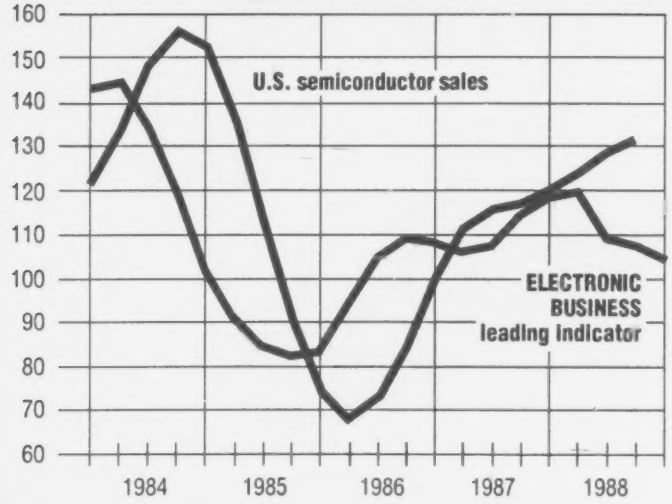
Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, except industrial production, SIC 357-9. Forecasts: Cahners Economics

# BUSINESS BAROMETER

**FORECASTS FOR ELECTRONICS, COMPUTERS AND SYSTEMS**

## ELECTRONIC BUSINESS leading indicator

**Quarterly** (rate-of-change)




The ELECTRONIC BUSINESS leading indicator predicts turning points in U.S. semiconductor sales with about a three- to nine-month leadtime. For more information please contact Elizabeth Baatz, senior economist, Cahners Publishing Co., 275 Washington St., Newton, Mass., 02158, or call (617) 558-4368

**Monthly** (rate-of-change)

This past August, for the fourth month in a row, the ELECTRONIC BUSINESS leading indicator barely moved from the 108.5 level. That's an unusual pattern of stability for this business cycle which suggests 1989 will be a flat year for semiconductors and electronic equipment growth.

Source: Cahners Economics

## Electronics industry indicators this month

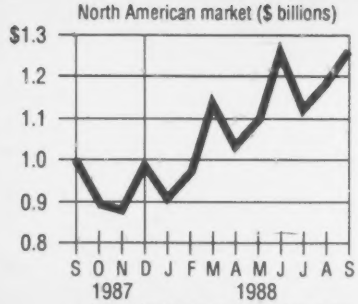
| | Latest month | Previous month | Year ago | 1987 average |
|---|---|---|---|---|
| **ELECTRONIC BUSINESS leading indicator** (rate-of-change, Aug.) | 108.7 | 103.5 | 113.6 | 111.1 |
| **U.S. semiconductor bookings** ($ millions, 3-month average, Sept.) | $1,154 | $1,209 | $967 | $951 |
| **Weekly hours of semiconductor production workers** (monthly average, Aug.) | 40.1 | 40.0 | 40.4 | 40.6 |
| **Electronic components leadtime index** (1977 = 100, Oct.) | 109.4 | 114.2 | 110.5 | 100.7 |
| **S&P's semiconductor stock price index** (1970 =10, monthly average, Sept.) | 51.0 | 54.1 | 82.1 | 65.5 |
| **Change in electronic components inventories** ($ millions, SA, Aug.) | +$119 | +$152 | +$84 | +$41 |
| **Contract and orders for plant and equipment** ($ billions, SA, Aug.) | $43.1 | $40.6 | $34.9 | $34.5 |

SA = seasonally adjusted, all other data is not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Commerce Department, U.S. Bureau of Economic Analysis

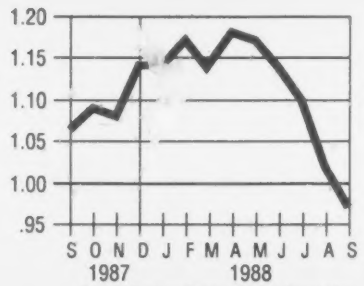
### Semiconductor sales

North American market ($ billions)




Source: Semiconductor Industry Association

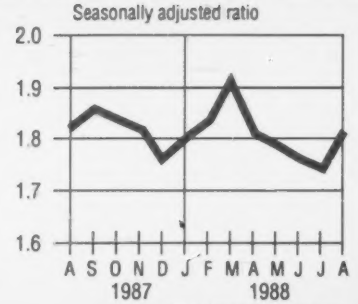
### Semiconductor book-to-bill ratio




Source: Semiconductor Industry Association

### Component inventory-to-shipments

Seasonally adjusted ratio




Source: U.S. Commerce Department